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SELECTED WATER RESOURCES ABSTRACTS

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FEBRUARY 1, 1978



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SELECTED WATER RESOURCES ABSTRACTS

A Semimonthly Publication of the Water Resources Scientific Information Center, Office of Water Research and Technology,
U.S. Department of the Interior



VOLUME 11, NUMBER 3
FEBRUARY 1, 1978

W78-00901 -- W78-01183

The Secretary of the U.S. Department of the Interior has determined that the publication of this periodical is necessary in the transaction of the public business required by law of this Department.

Use of funds for printing this periodical has been approved by the Director of the Office of Management and Budget through August 31, 1978.

SEIGLED RESONCES AWA

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

FOREWORD

Selected Water Resources Abstracts, a semimonthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. The contents of these documents cover the water-related aspects of the life, physical, and social sciences as well as related engineering and legal aspects of the characteristics, conservation, control, use, or management of water. Each abstract includes a full bibliographical citation and a set of descriptors or identifiers which are listed in the **Water Resources Thesaurus**. Each abstract entry is classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the Federal Council for Science and Technology.

WRSIC IS NOT PRESENTLY IN A POSITION TO PROVIDE COPIES OF DOCUMENTS ABSTRACTED IN THIS JOURNAL. Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources.

Selected Water Resources Abstracts is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several planned services of the Water Resources Scientific Information Center (WRSIC). The Center was established by the Secretary of the Interior and has been designated by the Federal Council for Science and Technology to serve the water resources community by improving the communication of water-related research results. The Center is pursuing this objective by co-ordinating and supplementing the existing scientific and technical information activities associated with active research and investigation program in water resources.

To provide WRSIC with input, selected organizations with active water resources research programs are supported as "centers of competence" responsible for selecting, abstract-

ing, and indexing from the current and earlier pertinent literature in specified subject areas.

Additional "centers of competence" have been established in cooperation with the Environmental Protection Agency. A directory of the Centers appears on the inside back cover.

Supplementary documentation is being secured from established discipline-oriented abstracting and indexing services. Currently an arrangement is in effect whereby the Bio-Science Information Service of Biological Abstracts supplies WRSIC with relevant references from the several subject areas of interest to our users. In addition to Biological Abstracts, references are acquired from Bioresearch Index which are without abstracts and therefore also appear abstractless in SWRA. Similar arrangements with other producers of abstracts are contemplated as planned augmentation of the information base.

The input from these Centers, and from the 51 Water Resources Research Institutes administered under the Water Resources Research Act of 1964, as well as input from the grantees and contractors of the Office of Water Research and Technology and other Federal water resource agencies with which the Center has agreements becomes the information base from which this journal is, and other information services will be, derived; these services include bibliographies, specialized indexes, literature searches, and state-of-the-art reviews.

Comments and suggestions concerning the contents and arrangements of this bulletin are welcome.

Water Resources Scientific Information Center
Office of Water Research and Technology
U.S. Department of the Interior
Washington, DC 20240

CONTENTS

FOREWORD iii

SUBJECT FIELDS AND GROUPS

Please use the edge index on the back cover to locate Subject Fields and Indexes.

01 NATURE OF WATER

Includes the following Groups: Properties; Aqueous Solutions and Suspensions

02 WATER CYCLE

Includes the following Groups: General; Precipitation; Snow, Ice, and Frost; Evaporation and Transpiration; Streamflow and Runoff; Groundwater; Water in Soils; Lakes; Water in Plants; Erosion and Sedimentation; Chemical Processes; Estuaries.

03 WATER SUPPLY AUGMENTATION AND CONSERVATION

Includes the following Groups: Saline Water Conversion; Water Yield Improvement; Use of Water of Impaired Quality; Conservation in Domestic and Municipal Use; Conservation in Industry; Conservation in Agriculture.

04 WATER QUANTITY MANAGEMENT AND CONTROL

Includes the following Groups: Control of Water on the Surface; Groundwater Management; Effects on Water of Man's Nonwater Activities; Watershed Protection.

05 WATER QUALITY MANAGEMENT AND PROTECTION

Includes the following Groups: Identification of Pollutants; Sources of Pollution; Effects of Pollution; Waste Treatment Processes; Ultimate Disposal of Wastes; Water Treatment and Quality Alteration; Water Quality Control.

06 WATER RESOURCES PLANNING

Includes the following Groups: Techniques of Planning; Evaluation Process; Cost Allocation, Cost Sharing, Pricing/Repayment; Water Demand; Water Law and Institutions; Nonstructural Alternatives; Ecologic Impact of Water Development.

07 RESOURCES DATA

Includes the following Groups: Network Design; Data Acquisition; Evaluation, Processing and Publication.

08 ENGINEERING WORKS

Includes the following Groups: Structures; Hydraulics; Hydraulic Machinery; Soil Mechanics; Rock Mechanics and Geology; Concrete; Materials; Rapid Excavation; Fisheries Engineering.

09 MANPOWER, GRANTS, AND FACILITIES

Includes the following Groups: Education—Extramural; Education—In-House; Research Facilities; Grants, Contracts, and Research Act Allotments.

10 SCIENTIFIC AND TECHNICAL INFORMATION

Includes the following Groups: Acquisition and Processing; Reference and Retrieval; Secondary Publication and Distribution; Specialized Information Center Services; Translations; Preparation of Reviews.

SUBJECT INDEX

AUTHOR INDEX

ORGANIZATIONAL INDEX

ACCESSION NUMBER INDEX

ABSTRACT SOURCES

SELECTED WATER RESOURCES ABSTRACTS

2. WATER CYCLE

2A. General

QUANTITATIVE MAP INTERPRETATION IN REGIONAL PLANNING SURVEYS (IN AFRIKAANS), Agricultural Research Station, Bethlehem (South Africa).

For primary bibliographic entry see Field 7C.
W78-00934

AREA-DEFICIT-INTENSITY CHARACTERISTICS OF DROUGHTS, Colorado State Univ., Fort Collins.

For primary bibliographic entry see Field 2B.
W78-01025

LATE PLEISTOCENE AND RECENT CLIMATIC CHANGES IN THE EGYPTIAN SAHARA, Southern Methodist Univ., Dallas, TX. Dept. of Anthropology. F. Wendorff.

The Geographical Journal, Vol. 143, No. 2, p 211-234, July, 1977, 7 fig, 1 tab, 20 ref.

Descriptors: *Climatic data, *Quaternary period, *Paleoclimatology, *Deserts, Playas, Basins, Water resources, Arid lands, Precipitation(Atmospheric), underground stream, Pleistocene epoch, Geologic history, Geology, Sediments, Climates.

Identifiers: *Egypt, *Sahara Desert, Nubian Desert.

Six seasons of investigation on the prehistory of the Egyptian Sahara have provided significant new data on climatic changes in that area during the Quaternary. Numerous playas, basins, and fossil springs occur in the Nubian Desert and point to more abundant water resources in the past. It is now evident that there were several moist intervals when the area supported the large herbivores hunted by man. These moist periods were separated by periods of hyperaridity when there appears to have been little or no life in the Egyptian Sahara. The present hyperarid climate did not develop until after c. 3000BC. It is believed that most of the moisture responsible for the high water tables during these intervals was the result of local precipitation sufficient to provide the ground cover needed to support the abundant fauna. Some movement of underground water from higher elevations outside Egypt is also likely, but the relative contributions of these two sources cannot be evaluated. (Jamail-Arizona)
W78-01043

HYDROLOGIC AND CHEMICAL BUDGETS ON WALKER BRANCH WATERSHED-OBSERVATIONS AND MODELING APPLICATIONS, Oak Ridge National Lab., TN.

R. J. Raridon, D. E. Fields, and G. S. Henderson. Available from the National Technical Information Service, Springfield, VA 22161 as ORNL-NSF-EATC24, Price codes: A04 in paper copy, A01 in microfiche. ORNL/NSF/EATC-24. Work supported by National Science Foundation. July 1976. 52 p, 6 fig, 34 ref, 2 append.

Descriptors: *Hydrologic budget, *Watersheds(Basins), *Data collections, *Simulation analysis, *Computer models, Cadmium, Runoff, Evapotranspiration, Streams, Systems analysis, Water quality. Identifiers: *Chemical budget, Sensitivity analysis, Dissolved potassium, Hydrologic transport.

Data collected on Walker Branch Watershed for a six-year period have been analyzed and used for validation studies of the ORNL version of the

Wisconsin Hydrologic Transport Model. In addition to hydrologic budgets, chemical budgets for dissolved potassium and cadmium were studied. Measurements of wetfall and dryfall, together with hourly rainfall and daily evaporation data, provided the input for the computer program. Comparisons of simulated water and material transport on a monthly basis show good agreement with measured land runoff values. A discussion of parameter selection and sensitivity analysis for the model is included. (Bell-Cornell)
W78-01071

HYDROLOGIC DATA FOR THE VAMOOSA AQUIFER, EAST-CENTRAL OKLAHOMA, Geological Survey, Oklahoma City, OK. Water Resources Div.

J. J. D'Lugosz, and R. G. McClafflin. Open-file report 77-487, July 1977. 38 p, 4 fig, 3 tab, 29 ref.

Descriptors: *Hydrologic data, *Groundwater resources, *Streamflow, *Water quality, *Oklahoma, Water yield, Aquifers, Well data, Water users, Water levels, Available water, Chemical analysis.

Identifiers: *East-central Oklahoma.

The U.S. Geological Survey has collected data as part of an availability and water-quality study pertaining to the Vamoosa aquifer in east-central Oklahoma. This report makes available both published and unpublished records at approximately 413 wells and 225 surface water sites. In addition, 39 selected references to pertinent groundwater and geologic reports covering parts of the 8-county area are included. (Woodard-USGS)
W78-01076

A HYDROLOGIC DESCRIPTION OF KEYSTONE LAKE NEAR TAMPA, FLORIDA, Geological Survey, Tampa, FL. Water Resources Div.

For primary bibliographic entry see Field 2H.
W78-01088

SIMULATION OF THE INLET HYDROGRAPH FOR URBAN CATCHMENTS, Institute of Hydrology, Walliford(England).

For primary bibliographic entry see Field 2E.
W78-01147

2B. Precipitation

SOLAR ACTIVITY AND RAINFALL VARIATION OVER SOUTHERN AFRICA, University of the Witwatersrand, Johannesburg (South Africa). Dept. of Applied Mathematics.

T. G. J. Dyer. South African Journal of Science, Vol 71, p 369-372, December 1975. 10 fig, 1 tab, 14 ref.

Descriptors: *Solar radiation, Weather patterns, *Rainfall, Climatic data, Temporal distribution, Stochastic hydrology, Precipitation, Weather forecasting.

Identifiers: South Africa, Transvaal, Karoo.

An investigation is reported of the relations between changes in solar activity, as measured by sunspot numbers, and rainfall variation over South Africa as measured by total annual receipts of rainfall at 157 rainfall stations over the period 1910-1972. The data indicate that there is a statistically significant correlation between some rainfall series of South Africa and the two solar cycles. (So. African Water Info. Center)
W78-00939

ASSESSMENT OF DRYNESS AND WETNESS BASED ON PRECIPITATION, WATER SUPPLY

IN THE SOIL AND POTENTIAL EVAPOTRANSPIRATION (IN SERBO-CROATIAN), Zagreb Univ. (Yugoslavia).

I. Penzar, and B. Penzar. Poljopr. Znan. Smotra 36(46): 113-138. 1976. (English summary).

Descriptors: *Soil water, *Evapotranspiration, Soil moisture, Palmer's method, Precipitation(Atmospheric), Yugoslavia.

A study of the hydric regime in North-West Croatia (Yugoslavia) is made on the basis of meteorological data of the Zagreb Observatory, Grcic, from 1862 to September 1975 inclusive. Values of potential evapotranspiration are analyzed, calculated from the air temperature after Thornthwaite. The difference between the amount of water obtained through precipitation and the amount that may be used for evapotranspiration is considered. It is shown that there is often insufficient precipitation water in the hot part of the year. However, if the water supply in the soil is taken into account in addition to precipitation, the hydric regime seems more favorable. For the study of the dry and wet periods in relation to agriculture, only the soil water in the arable layer was taken into consideration, whereas for forestry, pomology and viniculture, the total water supply to the depth of 1 m was considered. The water content in discrete soil layers was calculated by Palmer's method. Finally, a chronological list is given of the normal and abnormal hydric conditions in the last 114 yr. --Copyright 1977, Biological Abstracts, Inc.
W78-01017

AREA-DEFICIT-INTENSITY CHARACTERISTICS OF DROUGHTS, Colorado State Univ., Fort Collins.

N. Tase. Hydrology Papers No 87, November 1976. 47 p, 36 fig, 16 tab, 49 ref.

Descriptors: *Droughts, *Model studies, *Stochastic processes, Time series analysis, Mathematical models, Hydrology, Reviews, Precipitation(Atmospheric), Monthly, Probability, Equations, Mathematical studies, Great Plains.

Identifiers: *Areal droughts, Drought deficit, Drought intensity, Theory of run, Theory of recurrent events, Periodic-stochastic process.

Under the concept that monthly precipitation series over an area are composed of deterministic components specified by periodic parameters and a stationary stochastic component, a mathematical model of area-time process of monthly precipitation, especially of the stationary stochastic component, using the Upper Great Plains in the U.S.A. as an example of the model, was developed. The independent, identically distributed variables were obtained from the transformed stochastic component. The regional dependence structure was given by an exponential decay function with the interstation distance. By using the model, new samples of time series over the area at a new grid of 80 points were generated in order to investigate area-deficit-intensity characteristics of droughts. Probabilities of areal coverage of droughts were investigated further by applying the theory of runs, by applying the theory of recurrent events, and by similar approaches. Probabilities of specific areas covered by droughts of given properties also were investigated by considering the effects of the size and the shape of an area. (Lee-ISWS)
W78-01025

COMPUTATIONS WITH THE RAND CLOUD MODEL FOR THE HIPEX WORKSHOP, JUNE 1975, Rand Corp., Santa Monica, CA.

F. W. Murray.

Field 2—WATER CYCLE

Group 2B—Precipitation

Available from the National Technical Information Service, Springfield, VA 22161 as ADA-022 268, Price codes: A03 in paper copy, A01 in microfiche. Report, July 1975. 40 p, 13 fig, 2 tab, 1 ref.

Descriptors: *Cloud physics, *Model studies, *Mathematical models, Weather, Precipitation(Atmospheric), Rainfall, Nucleation, Computers, Atmosphere, Clouds, Equations, Water vapor, Droplets, Temperature, Humidity, Meteorology.

Identifiers: *Cloud models, *High Plains region.

The High Plains Cooperative Experiment sponsored by the Division of Atmospheric Water Resource Management of the Bureau of Reclamation is a largescale project to study the feasibility of augmenting precipitation in the High Plains region by artificial means. In July 1974, a planning workshop was held in Vail, Colorado, at which intensive studies of the requirements for cloud modeling, measurements, and design and evaluation were made. One recommendation that came from the modeling sessions was that all of the models developed by the various participants be tested with the same set of data, and that another workshop be convened to compare the results. Data for two days, 10 and 17 August 1973, for the St. Louis region from Project METROMEX were provided. The modeling workshop was held in Denver on 11-13 June 1975. Approximately 14 participants presented results of their models. Limitations of time made it impossible to complete the computer runs of the Rand Cloud Model before the date of the workshop, so only partial results were presented. Since that time, two complete runs have been made and the results are reported. (Sims-ISWS)

W78-01063

PACIFIC SEA-SURFACE TEMPERATURE RELATED TO RAIN IN CALIFORNIA,

California State Univ., Fresno. Dept. of Geography.

C. G. Markham, and D. R. McLain.

Nature, Vol. 269, No. 5628, p 501-504, October 6, 1977. 3 fig, 1 tab, 7 ref.

Descriptors: *Rainfall, *California, *Water temperature, *Pacific Ocean, Temperature, Oceans, Weather, Air circulation, Precipitation(Atmospheric), Correlation analysis, Analytical techniques, Meteorology, Oceanography.

Identifiers: *Sea surface temperature.

California is experiencing the worst drought in modern history, and there is much concern and speculation about future rainfall prospects. Recently South Atlantic sea surface temperatures (SST) were related to rain in northeastern Brazil. Here similar methods were used to relate sea surface temperatures over the North Pacific Ocean to rainfall in California. December SST in the northeast Pacific off Washington were found to have a limited but definite predictive value and to account for about 45% of the variation in California rainfall for the period February-April. (Sims-ISWS)

W78-01066

THE 1976 AND 1977 DROUGHT IN CALIFORNIA: EXTENT AND SEVERITY,

California Univ., Davis. Dept. of Geography.

M. L. Shelton.

Weatherwise, Vol. 30, No. 4, p 139-146, 153, August 1977. 2 fig, 3 tab, 2 ref.

Descriptors: *Droughts, *California, *Water shortage, Precipitation(Atmospheric), Rainfall, Snowfall, Seasonal, Spatial distribution, Effects, Distribution patterns, Water resources, Agriculture, Climatology, Meteorology.

Identifiers: Drought severity.

Many stations in California experienced their most severe drought of this century during the 1976 and

1977 precipitation years. The unseasonable dry weather adversely affected agriculture, recreation, and water supplies throughout the state. During 1976, agriculture and the ski industry experienced large financial losses because precipitation was insufficient to support normal activities, range and forest fires burned approximately 165,000 acres of dry vegetation, and an acute water shortage in Marin County prompted one city to discourage tourists. The impact of the drought probably would have been even greater, but the statewide system of water shortage and transfer was able to compensate for natural water shortages by providing water to many affected areas. Moisture deficits at the seven stations selected as representative of various climatic regions in California indicate that the 1976 drought was more severe at a majority of these sites than the record dry year drought of 1924. Only the south coastal area represented by Los Angeles experienced a more severe drought during 1924 than during 1976. The statewide drought pattern suggested by the data for the representative stations is that the 1976 drought appeared in the state earlier than the 1924 drought, but it spread throughout the state more slowly than the 1924 drought. (Sims-ISWS)

W78-01134

A HIGH-RESOLUTION ELECTRONIC RAINFALL INTENSITY RECORDER AND TOTALISER,

Meteorological Office, Poona (India).

G. Venugopal, and V. Radhakrishnan.

Indian Journal of Meteorology, Hydrology and Geophysics, Vol. 27, No. 4, p 441-444, October 1976. 4 fig.

Descriptors: *Rain gages, *Rainfall intensity, *Instrumentation, Precipitation gages, Rainfall, Measurement, Gages, Equipment, Electronic equipment, Meteorology, Electrical engineering.

Identifiers: Recorders, Recording systems, Rainfall recorders.

An electronic distant-reading rainfall intensity recorder capable of measuring minute-to-minute values of the intensity of rain and recording them of a strip-chart recorder was designed and constructed at the Instruments Division of the Meteorological Office, Poona. The system measures the intensity of rainfall by converting rainfall into drops of equal size and counts the number of drops by an optical-cum-electronic device. The number of counts during every minute interval which constitutes a measure of the intensity of rainfall are recorded on a conventional strip-chart recorder. To measure the total rainfall during any given interval of time, an additional mark is printed on the chart for every 1 mm of rainfall. The system, which has a resolution of 1/2 mm of rain/hour, was tested during several spells of rainfall at Poona and was found to record quite accurately. (Sims-ISWS)

W78-01142

A MARKOV CHAIN MODEL FOR THE OCCURRENCES OF DRY AND WET DAYS,

Gauhati Univ. (India). Dept. of Statistics.

J. Medhi.

Indian Journal of Meteorology, Hydrology and Geophysics, Vol. 27, No. 4, p 431-435, October 1976. 3 tab, 7 ref.

Descriptors: *Rainfall, *Model studies, *Mathematical models, Markov processes, Data processing, Weather, Rain, Foreign research, Monsoons, Statistics, Statistical models, Meteorology.

Identifiers: *India, *Gauhati(India), Dry spells, Wet spells.

Study of rainfall data in India began as early as 1889 with the work of Blanford. His work was extended by Sir Gilbert Walker, Mahalanobis, in his classic work (Sankhya 5:p 1-20, 1940), broke en-

tirely new grounds with sound statistical reasonings in his study of the rainfall, runoff, and other meteorological features of the river basins of Orissa. Models based on stochastic processes and time series now are being applied in meteorological studies. Gabriel and Neumann used a Markov chain model in a study of weather conditions in Tel Aviv. A similar Markov chain model for the occurrence of dry and wet days in Gauhati (Airport) and to test the statistical significance of the model. (Sims-ISWS)

W78-01143

INFLUENCE OF CERTAIN FACTORS ON RAINFALL FREQUENCY VALUES,

Meteorological Office, New Delhi (India).

N. Tripathi.

Indian Journal of Meteorology, Hydrology and Geophysics, Vol. 27, No. 4, p 423-430, October 1976. 4 tab, 11 ref.

Descriptors: *Rainfall, *Probable maximum precipitation, *Frequency analysis, Precipitation(Atmospheric), Data processing, Analytical techniques, Temporal distribution, Precipitation excess, Air pollution, Urbanization, Effects, Statistics, Weather, Meteorology.

Identifiers: *India, Gumbel's method, Return periods.

Based on 84-year data of Calcutta, Delhi, Bombay, and Madras, it was found that to estimate the maximum one-day point rainfall for long return periods, more reliance is to be placed on stations with the longest records. For the error to be within plus or minus 25% in about 80% of cases, in the estimation of return period values, extrapolation may be made to five times the period of record and to ten times the period of record if the outliers are excluded from the series. Criteria to find the outliers were suggested. Some evidence was found to show that the return period values of rainfall of a station increase with increase in air pollution at that station. (Sims-ISWS)

W78-01144

MONSOON IN SIERRA LEONE,

Regional Meteorological Centre, Bombay (India).

A. K. Mukherjee.

Indian Journal of Meteorology, Hydrology and Geophysics, Vol. 27, No. 4, p 385-390, October 1976. 9 fig, 2 tab, 3 ref.

Descriptors: *Rainfall, *Monsoons, *Africa, Frequency analysis, Diurnal, Seasonal, Spatial distribution, Temporal distribution, Precipitation(Atmospheric), Tropical regions, Statistics, Statistical analysis, Meteorology.

Identifiers: *Sierra Leone, *India.

General characteristics of monsoons in Sierra Leone are discussed. The months July, August, and September may be considered as monsoon months in Sierra Leone. Most of the rain in this country occurs in the mentioned three months. Rainfall data for the period 1954 to 1973 were analyzed. Rainfall gradually decreases from west to east and from south to north. Though the rainfall increases in monsoon, there is considerable reduction in thunderstorm activity. The diurnal variation of rainfall indicates that the rainfall is maximum in early morning and minimum in the evening. A comparison of rainfall characteristics was made with those over the west coast of India. (Sims-ISWS)

W78-01145

SIMULATION OF THE INLET HYDROGRAPH FOR URBAN CATCHMENTS,

Institute of Hydrology, Wallingford(England).

For primary bibliographic entry see Field 2E.

W78-01147

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WATER CYCLE—Field 2

Snow, Ice, and Frost—Group 2C

RAINFALL INTENSITY-FREQUENCY RELATIONSHIPS FROM MONTHLY EXTREMES,
Guelph Univ. (Ontario). School of Engineering.
T. Dickinson.
Journal of Hydrology, Vol 35, No 1/2, p 137-145,
October 1977. 5 fig, 1 tab, 6 ref.

Descriptors: *Rainfall, *Frequency analysis,
*Excessive precipitation, *Canada, Frequency,
Frequency curves, Precipitation(Atmospheric),
Climatology, Probability, Monthly, Seasonal, An-
nual, Variability, Meteorology, Hydrology.
Identifiers: *Rainfall frequency.

An approach is outlined for the development of rainfall extreme value distributions utilizing many extreme values per year. In particular, an extremal distribution is developed on the basis of monthly extremal distributions which are double exponential in form. The approach, applied to rainfall extremes of various durations at three stations in southern Ontario, offers an alternative to the estimation of distributions using only annual extremes. The alternative was shown to be less sensitive to the effects of outlier points and increases the utilization of rainfall information. It also revealed seasonal patterns of rainfall extremes which may be important for the consideration of rainfall-runoff determination. (Sims-ISWS)
W78-01149

**METEOROLOGICAL ADJUSTMENT OF
YEARLY MEAN VALUES FOR AIR POLLUTANT CONCENTRATION COMPARISONS,**
National Aeronautics and Space Administration,
Cleveland, OH. Lewis Research Center.

S. M. Sidik, and H. E. Neustadter.

Available from the National Technical Information Service Springfield, VA 22161 as N76-29738, Price codes: A03 in paper copy, A01 in microfiche. Technical Note D-8253, July 1976. 42 p, 10 fig, 4 tab, 19 ref, 1 append.

Descriptors: *Air pollution, *Pollutants, *Model studies, Mathematical models, Regression analysis, Suspended solids, Sulfur compounds, Nitrogen compounds, Meteorological data, Winds, Air temperatures, Precipitation(Atmospheric), Weather, Meteorology.
Identifiers: *Meteorological effects, Sulfur dioxide, Nitrogen dioxide, Suspended particles, Air pollution control.

Using multiple linear regression analysis, models were derived which estimate mean concentrations of Total Suspended Particulate (TSP), sulfur dioxide (SO₂), and nitrogen dioxide (NO₂) as a function of several meteorologic variables, two rough economic indicators, and a simple trend in time. Considered were 24-hour averaged concentrations measured in Cleveland, Ohio, from 1967 to 1972 (approximately 450 observations for TSP and 400 observations at 13 sites for SO₂ and NO₂) by the municipal Division of Air Pollution Control. Meteorologic data were obtained from the National Weather Service. The data did not include inversion heights. This is representative of data typically available to a local pollution-control agency. The goodness of fit of the estimated models is partially reflected by the squared coefficient of multiple correlation which indicates that, at the various sampling stations, the models accounted for about 23 to 47% of the total variance of the observed TSP concentrations. If the resulting model equations are used in place of simple overall means of the observed concentrations, there is about a 20% improvement in either (1) predicting mean concentrations for specified meteorological conditions, or (2) adjusting successive yearly averages to allow for comparisons devoid of meteorological effects. This improvement can be obtained with no additional cost other than a moderate effort at statistical analysis. An application to source identification was presented, using regression coefficients of wind velocity predictor variables. (Sims-ISWS)
W78-01153

2C. Snow, Ice, and Frost

RADIOCARBON DATING OF THE LAST GLACIATION IN PERU,
Ohio State Univ. Research Foundation, Columbus, Inst. of Polar Studies.

J. H. Mercer, and M. O. Palacios.
Geology, Vol. 5, No. 10, p 600-604, October 1977. 2 fig, 1 tab, 26 ref. NSF GV-41411, ATM75-15513.

Descriptors: *Glaciers, *Radioactive dating,
*Glaciation, *South America, On-site investigations, Ice, Glacial drift, Mountains, Fluctuations, Dating, Geomorphology, Alpine, Glaciology.
Identifiers: *Peru, *Cordillera Vilcanota(Peru), *Quelccaya Ice Cap(Peru).

In the Cordillera Vilcanota and the vicinity of the Quelccaya ice cap, near lat 14 deg S in eastern Peru, the last glaciation culminated sometime between about 28,000 and 14,000 B.P. Alpine glaciers were then only about half as long as during an earlier glaciation of unknown date. A rather minor readvance of the Quelccaya ice cap was in progress about 11,500 B.P. and culminated about 11,000 B.P., some 500 to 800 yr before the Younger Dryas Stade in Europe. By 10,000 B.P., the Quelccaya ice cap was little, if any, larger than it is today, and it was smaller than it is today between about 2700 and 1600 B.P. Glacier fluctuations during the interval 10,000 to 3000 B.P. have not yet been determined. A 'Little Ice Age' maximum culminated between 600 and 300 B.P. The relative importance of changes in temperature and precipitation in causing these glacier variations is uncertain. (Sims-ISWS)
W78-01009

1974 ICE BREAKUP ON THE CHENA RIVER,
Cold Regions Research and Engineering Lab., Fairbanks, Alaska. Alaskan Projects Office.

T. McFadden, and M. Stallion.
Available from the National Technical Information Service, Springfield, VA 22161 as ADA-018 352, Price codes: A04 in paper copy, A01 in microfiche. Special Report 241, October 1975. 49 p, 25 fig, 4 tab, 52 ref, 4 append.

Descriptors: *Ice, *Rivers, *Ice breakup, *Alaska, Ice jams, Bridges, Dams, Piers, Ice cover, Water temperature, Air temperature, On-site investigations, Aerial photography, Damages, Cold regions.
Identifiers: *Chena River(Alaska), Ice thickness, River ice.

The Corps of Engineers, Alaska District, requested CRREL to observe and document the ice breakup of the Chena River in the spring of 1974. The purpose was to determine the potential for ice and debris damage to the outlet structure of the proposed Chena River Flood Control Dam. Accordingly, the Alaskan Projects Office of CRREL made a detailed study of the ice breakup, ice jams, and ice thickness on the Chena River prior to and during the actual breakup. Ice thickness were measured at specific locations on the Chena River, from its confluence with the Tanana River upstream to the first bridge on the Chena Hot Springs Road. Average ice thicknesses were computed, as well as average ice volumes per mile of river length. Water temperatures and velocities were measured at different locations on the river. Aerial and ground reconnaissance was maintained on the river during the breakup period, and ground parties were dispatched to almost all ice jams observed on the river. Comparisons to other years' breakups were made, and it was concluded that the 1974 breakup was extremely mild. (Sims-ISWS)
W78-01013

AVALANCHE RELEASE AND SNOW CHARACTERISTICS, SAN JUAN MOUNTAINS, COLORADO.

Colorado Univ., Boulder. Inst. of Arctic and Alpine Research.

Occasional Paper No. 19, May 1976. 268 p, 80 fig, 32 tab, 25 ref, 8 append. Armstrong, R.L., and Ives, J.D., editors. USBR 14-06-D-7155.

Descriptors: *Avalanches, *Colorado, *Snow, *Mathematical models, *Forecasting, Statistical methods, On-site investigations, Computer programs, Data processing, Networks, Snow cover, Seismic studies, Seismic properties, Snow management, Analytical techniques, Instrumentation, Monitoring, Weather modification, Methodology, Data collections.
Identifiers: *San Juan Mountains(Colo), *Red Mountain Pass(Colo).

The project objective was to develop a methodology to forecast accurately avalanche occurrences through study of the complex relationship which exists among terrain, climate, snow stratigraphy, and avalanche formation. The primary snow study site located at Red Mountain Pass (3400 m) included instrumentation to measure air temperature, temperatures within the snowpack, wind speed and direction, precipitation rate and amount, snow settlement rate, and net all-wave radiation at the snow surface. Seismic and infrasonic instrumentation for avalanche event detection was investigated during the first two winters, but neither of these systems proved feasible. Avalanche events were monitored by direct observation of 214 avalanche paths. A statistical forecast model based on discriminant function analysis of four years of data was developed. This model which, for major avalanche cycles during the dry and wet snow seasons, has an accuracy of 88% and 82% respectively, is also the first to be applied to groups of starting zones and individual paths, and to predict magnitude of avalanche occurrence. Evidence suggested that avalanche release within sub-freezing snow layers is primarily dependent on precipitation to trigger unstable layers deep within the snowcover. Delayed-action events are extremely rare. (Humphreys-ISWS)
W78-01062

COMPARISON OF DIFFERENT METHODS FOR ESTIMATING SNOWCOVER IN FORESTED, MOUNTAINOUS BASINS USING LANDSAT (ERTS) IMAGES,
Geological Survey, Tacoma, WA. Water Resources Div., and Stanford Research Institute, Menlo Park, CA.
For primary bibliographic entry see Field 7B.
W78-01095

CENOZOIC EVOLUTION OF ANTARCTIC GLACIATION, THE CIRCUM-ANTARCTIC OCEAN, AND THEIR IMPACT ON GLOBAL PALEOCEANOGRAPHY,
Rhode Island Univ., Kingston. Graduate School of Oceanography.
For primary bibliographic entry see Field 2L.
W78-01138

ICE FORCE MEASUREMENTS ON THE PEMBINA RIVER, ALBERTA, CANADA,
Army Terrestrial Sciences Center, Hanover, NH. Applied Research Branch.
F. D. Haynes, D. E. Nevel, and D. R. Farrell.
Available from the National Technical Information Service, Springfield, VA 22161 as AD-A018 223, Price codes: A02 in paper copy, A01 in microfiche. Technical Report 269, October 1975. 16 p, 7 fig, 5 tab, 12 ref.

Descriptors: *Ice, *Ice loads, *Rivers, *Canada, On-site investigations, Measurement, Bridges, Piers, Pressure, Loads(Forces), Ice breakup, Ice cover, Ice jams, Piles(Foundations), Cold regions.
Identifiers: *Pembina River(Alberta), River ice.

In 1972, just before spring breakup, 23 in situ tests were conducted on the Pembina River, in Alberta, Canada, to measure ice forces. The tests simulated an ice sheet pushing against a bridge pier. The ap-

Field 2—WATER CYCLE

Group 2C—Snow, Ice, and Frost

paratus utilized a hydraulic ram to push a 5.5-in (14.0-cm) wide vertical pile section horizontally against the ice sheet, which varied from 11.5 to 19.5 in (29.2 to 49.5 cm) in thickness. The velocity of the pile was varied from 0.07 to 21 in/sec (0.18 to 53.3 cm/sec) by hydraulic flow control valves. Both flat and round piles were used to represent the pier. Some tests began with the piles a few inches away from the ice sheet, whose edge was cut flat. Other tests began with the pile in contact with the ice sheet. For some of the round pile tests, augered holes were used to provide better initial contact. The in situ test results were compared with the ice force measurements made by other workers on a nearby bridge pier during ice breakup. The in situ test ice forces were about 50% higher than the bridge pier test results. The disagreement was caused by a difference between the sizes of the piles and the size of the pier and a three-day warming of the ice before the ice impacted against the pier. (Sims-ISWS) W78-01154

2D. Evaporation and Transpiration

STUDY OF MASS TRANSFER AT THE AIR-WATER INTERFACE BY AN ISOTOPIC METHOD,
CEA Centre d'Etudes Nucleaires de Saclay, Gif Sur Yvette (France).
L. Merlivat, and M. Coantic.
Journal of Geophysical Research, Vol. 80, No. 24, p 3455-3464, August 20, 1975. 8 fig, 1 tab, 22 ref, 4 append.

Descriptors: *Evaporation, *Air-water interfaces, *Mass transfer, *Isotope studies, Laboratory tests, Model studies, Winds, Water, Water vapor, Turbulent boundary layers, Turbulent flow, Momentum equation, Oxygen, Hydrogen, Deuterium, Oceans, Physical properties.
Identifiers: Wind tunnels.

The calculation of evaporation flux is based on certain assumptions concerning processes in the vicinity of the air-water interface. Most of the recently proposed evaporation theories differ mainly in the estimated contributions of molecular and turbulent mass transfer in the vapor phase just above the liquid surface. By analyzing the hydrogen and oxygen stable isotope distribution in liquid water and water vapor, it was shown that processes taking place on a very small scale near the liquid can be investigated. The effect of molecular mass transfer was directly obtained without having to perform difficult measurements in the air in the immediate vicinity of the water surface. Experiments were carried out in the Institut de Mecanique Statistique de la Turbulence air-water tunnel specially designed for the simulation of ocean-atmosphere energy exchanges. The wind velocities varied from 0.7 to 7 m/s. The experimental results obtained did not support the classical Reynolds analogy between momentum and mass transfer down to the interface and the theory proposed by Sheppard, but they were in agreement with Sverdrup's, Kitaigorodskiy and Volkov's, and Brutsaert's theories, all of which involve a layer just above the air-water interface through which mass transfer is dominated by molecular diffusion. (Sims-ISWS) W78-00977

ASSESSMENT OF DRYNESS AND WETNESS BASED ON PRECIPITATION, WATER SUPPLY IN THE SOIL AND POTENTIAL EVAPOTRANSPIRATION (IN SERBO-CROATIAN),
Zagreb Univ. (Yugoslavia).
For primary bibliographic entry see Field 2B.
W78-01017

MULTIPLE ESTIMATES OF LAKE ERIE EVAPORATION,

National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
J. A. Derecki.

Journal of Great Lakes Research, Vol. 2, No. 1, p 124-149, July 1976. 12 fig, 11 tab, 19 ref.

Descriptors: *Lake Erie, *Evaporation, *Analytical techniques, *Great Lakes, Water balance, Mass transfer, Energy budget, Precipitation, Runoff, Inflow, Discharge(Water), Storage, Water temperature, Winds, Solar radiation, Ice cover, Heat transfer, Lakes, Limnology, Reliability, Estimating.
Identifiers: *Lake Hefner equations.

Evaporation from large lakes cannot be measured directly, but several methods have been developed to compute lake evaporation. Because of the Great Lakes data limitations, evaporation determined by a single method is not sufficiently reliable and requires verification of accuracy by different methods. Monthly evaporation from Lake Erie was derived by the water budget, selected mass transfer, and the energy budget approaches. The period of record varies with the availability of data, 1937-68 for the water budget and mass transfer methods, and 1952-1968 for the energy budget method. Evaporation determined by the water budget method was used to provide control for the other methods. The evaporation rates varied from -9 to 25 cm/month with periods of low, median, and high annual evaporation averaging approximately 80, 90, and 100 cm. The analysis of results indicated that reasonably accurate evaporation estimates during the year can be obtained by the water budget and the modified Lake Hefner mass transfer equations. (Sims-ISWS) W78-01035

2E. Streamflow and Runoff

ASPECTS OF THE FRESHWATER MOLLUSCA OF THE PONGOLA RIVER FLOOD PLAIN PANS,

South African Medical Research Council, Potchefstroom; and Potchefstroom Univ. for C. H. E. (South Africa).

S. J. Pretorius, A. C. Jennings, D. J. Coertze, and J. A. Van Eeden.
South African Journal of Science, Vol. 71, p 208-212, July 1975. 1 fig, 9 tab.

Descriptors: Mollusca, Flood plain, Snails, Ecological distribution, Species identification, Biomass concentration, Intermediate hosts, Schistosomiasis, Bilharzia.
Identifiers: Pongola River, J G Strydom Dam, Makatini Flats, South Africa, Bulinus(Physopsis) africanus, Biomphalaria pfeifferi.

A survey of the freshwater molluscs of the Pongola River flood plain pans was made during 1971. The identity and distribution of the molluscs in the various pans are given. A snail density and snail biomass comparison is made between a deep pan with abundant and a shallow pan with sparse vegetation. The mollusc fauna differed very little in the two pan types although different species predominate numerically in each and, likewise, different species accounted for the greater percentage of biomass. The two intermediate hosts of human schistosomiasis, Bulinus (Physopsis) africanus and Biomphalaria pfeifferi, seem to be among the most successful species in the pans, leaving little doubt that the future irrigation scheme on the Makatini flats could be a very dangerous schistosomiasis area. (So. African Water Info. Center) W78-01008

GRAVITY WAVES ON A CURRENT: THE INFLUENCE OF VORTICITY, A SLOPING BED, AND DISSIPATION,

Technical Univ. of Denmark, Lyngby, Inst. of Hydrodynamics and Hydraulic Engineering. O. Brink-Kjaer.

Series Paper No. 12, 1976. 137 p, 17 fig, 65 ref, 1 append.

Descriptors: *Waves(Water), *Gravity waves, *Mathematical studies, *Open channels, Mathematics, Equations, Analytical techniques, Analysis, Theoretical analysis, Free surfaces, Currents(Water), Velocity, Distribution patterns, Shallow water, Deep water, Open channel flow, Potential flow, Rotational flow, Energy dissipation, Numerical analysis, Wave lengths, Flow, Vortices.
Identifiers: Two-dimensional flow.

Periodic surface gravity water waves propagating on a shear current were investigated for two-dimensional flow. The influences of vorticity, a gently sloping sea bed, and dissipation were studied, the former by assuming a linear current profile. In the case of a horizontal bed and no dissipation, analytical expressions correct to second order were found for phase and group velocity, wave profile, particle velocity, pressure, mean wave energy density, radiation stress, and total mean energy flux. In the case of a gently sloping sea bed and no dissipation, analytical expressions were found for the variations of wave amplitude and height of mean water level in a time-independent medium. When dissipation was taken into consideration, the vorticity of the current velocity was related to the roughness of the bed. Formulas were presented by which the mean bed stress and the mean energy loss were determined. Graphs were presented which illustrate the effects of vorticity, shoaling, and dissipation on the parameters which characterized the combined current and wave flow. (Humphreys-ISWS) W78-01014

POSSIBLE EFFECT OF SEDIMENTS AND CHANNEL PROCESSES ON RUNOFF REDISTRIBUTION IN A RIVER DELTA,
For primary bibliographic entry see Field 2J.
W78-01029

FRICITION FACTORS FOR VEGETATED WATERWAYS OF SMALL SLOPE,
Agricultural Research Service, Stillwater, OK. Water Conservation Structures Lab.
W. O. Ree, and F. R. Crow.
Report ARS-S-151, January 1977. 61 p, 57 fig, 34 tab.

Descriptors: *Friction, *Mannings equation, *Channels, *Grassed waterways, *Vegetation effects, Channel flow, Roughness(Hydraulic), Wheat, Sorghum, Cotton, Hydraulic properties, Hydraulic radius.
Identifiers: Small slope channels, *Terrace-channel design, Plant density and quality.

Experiments were conducted over a 4-year period to determine the friction factors (Manning n) for vegetated waterways of small slope. The plants used were wheat planted in 7-inch and 14-inch rows parallel to the flow, wheat in 7-inch rows perpendicular to the flow, sorghum and cotton in 40-inch rows parallel to the flow, sorghum in 20-inch rows parallel to the flow, and sudangrass, lespedeza, and lovegrass broadcast planted in the channels. For the poor-quality stands of wheat, there was little or no difference in the n value for the 7-inch and 14-inch rows, but for the good-quality stands, the n values for the 7-inch row spacing were considerably larger than those for the 14-inch row spacing. For the higher flows, which submerged the vegetation, row direction had no effect on the friction factor, but there was a large difference in the n values for the lower flows. A comparison of the n values at a hydraulic radius

WATER CYCLE—Field 2

Streamflow and Runoff—Group 2E

of 0.8 foot showed a value of 0.2 for the parallel rows and 0.4 for the perpendicular rows. For the 'Hegari' sorghum in 20-inch and 40-inch rows, there was a difference in then values for the low flows, with the wider row spacing having the lower value; but when the flow reached a hydraulic radius of about 1.5 feet, there was no difference in the n values for the two row spacings. (Bhowmik-ISWS)
W78-01031

DETROIT RIVER FLOW CHARACTERISTIC AND THEIR APPLICATION TO CHEMICAL LOADING ESTIMATES,

National Oceanic and Atmospheric Administration Ann Arbor, MI. Great Lakes Environmental Research Lab.

F. H. Quinn.
Journal of Great Lakes Research, Vol. 2, No. 1, p 71-77, July 1976. 2 fig, 4 tab, 2 ref.

Descriptors: *Flow, *Rivers, *Model studies, *Chlorides, Streamflow, Mathematical models, Wind tides, Seiches, Lakes, Variability, Spatial distribution, Sampling, Water quality, Water analysis, Statistical methods.

Identifiers: *Detroit River, Flow variation.

Unsteady flow characteristics were analyzed at the Windmill Point, Fort Wayne, Wyandotte, and Fermi sections of the Detroit River using 2 hydraulic transient mathematical models. Both models consisted of the complete one-dimensional equations of continuity and motion and were calibrated using discharge measurements taken during the 1963-1973 period. The models were used to generate hourly, daily, and monthly flows for the year 1968. A statistical analysis was made of the flows at the Fort Wayne and Fermi sections. The flows at the Fort Wayne section were representative of the entire river on a monthly basis and on a daily basis under most conditions. Individual section flows are necessary for use on an hourly basis or under Lake Erie wind, tide, and seiche conditions. Application of flows to computation of Detroit River chloride loadings shows entirely different loading phenomena for both base and peak loadings between the upper and lower river. It also illustrates the danger of computing yearly loadings based on a limited number of samples for the lower river. (Sims-ISWS)
W78-01035

RAINWATER AND SEDIMENT RUNOFF FROM SLOPES IN THE AZOV-KUBAN PLAIN,

Academy Nauk SSSR, Leningrad. Inst. Ozerovedeniya.

For primary bibliographic entry see Field 2J.

W78-01046

DIRECT MEASUREMENTS OF SECONDARY CURRENTS IN RIVER BENDS,

Colorado State Univ., Fort Collins. Engineering Research Center.

J. C. Bathurst, C. R. Thorne, and R. D. Hey.
Nature, Vol. 269, No. 5628, p 504-506, October 6, 1977. 3 fig, 18 ref.

Descriptors: *Rivers, *Flow, *Currents(Water), Measurement, Velocity, Streamflow, Current meters, On-site investigations, Data processing, Boundaries(Surfaces), Shear stress.

Identifiers: River bends, Secondary currents.

Fluids flowing through pipes or channels can develop secondary currents. The secondary currents were defined as currents which occur in the plane normal to the local axis of the primary flow. The development of the currents in straight channels has been ascribed to anisotropic turbulence and the non-uniform distribution of boundary shear stress, but in meander bends, they are caused by skewing of the flow. Secondary currents distort the distributions of primary isolovels and boundary shear stress from those expected in

simple flows and, therefore, have important implications for bed and bank erosion and for resistance to flow. Measurements are reported of longstream and cross stream velocities carried out across sections of a river perpendicular to the outer banks of several bends using electromagnetic flow meter. (Sims-ISWS)
W78-01067

EFFECTS OF URBAN LAKES ON SURFACE RUNOFF AND WATER QUALITY,

Wisconsin Univ.-Milwaukee. Dept. of Geological Sciences.

D. S. Cherkauer.
Water Resources Bulletin, Vol. 13, No. 5, p 1057-1067, October 1977. 4 fig, 2 tab, 6 ref.

Descriptors: *Watersheds(Basins), *Lakes, *Runoff, *Water quality, Surface runoff, Cities, Highways, Salts, Hydrographs, Storage, Effects, Chemicals, Chlorides, Magnesium, Dissolved solids, Outflow, Water pollution, Urbanization, Hydrology.

Identifiers: Road salt.

The effects of an artificial lake system upon the runoff hydrology of a small watershed were determined by comparing the quantity and quality of runoff with those of an adjacent and similar watershed containing no lakes. Lake storage reduced peak discharge and slowed flood recession rate downstream. Water stored within the lakes is generally of different quality than downstream surface runoff. Salt stored in the lakes from winter deicing is released during periods of surface runoff throughout the rest of the year. During summer or fall runoff events, lake outflow dominates the salt load of the outlet stream, generating double-peaked load hydrographs in which the second, or lake-induced, crest is many times large than the peak which corresponds to maximum flow. On the other hand, the lakes cause a reduction of salt loads and concentration in winter runoff. The concentration and loads of ions which are not related to road salt generally are affected less by the lakes, although they are increased substantially in the fall. (Sims-ISWS)
W78-01135

FITTING THE PEARSON TYPE 3 DISTRIBUTION IN PRACTICE,

Exeter Univ. (England).

J. Buckett, and F. R. Oliver.

Water Resources Research, Vol. 13, No. 5, p 851-852, October 1977. 1 tab, 4 ref.

Descriptors: *Streamflow, *Temporal distribution, *Model studies, Mathematical models, Equations, Flow, Frequency analysis, Hydrology.

Identifiers: *Pearson Type 3 distribution, Fitting equations.

The three-parameter Pearson type 3 distribution is frequently fitted to streamflow data, partly in order to estimate percentiles. This practical study confirmed that maximum likelihood methods can give very different, and much more satisfactory, estimates than the more usual method of moments. (Sims-ISWS)
W78-01136

THE INTERRELATIONSHIPS OF THE LONGITUDINAL PROFILES AND CHANNEL PATTERN FOR THE RED RIVER,

Missouri Univ., St. Louis. Dept. of Geology.

L. J. Lee, and B. L. Henson.

Journal of Hydrology, Vol 35, No 1/2, p 191-201, October 1977. 4 fig, 20 ref.

Descriptors: *Rivers, *Profiles, Meanders, Analytical techniques, Data processing, Correlation analysis, Braiding, Geomorphology, Valleys, River flow, Discharge water, Hydraulics.

Identifiers: *Red River, Longitudinal profiles.

The longitudinal river, valley, and regional profiles were plotted for the Red River. Plotting was done in such a way that specific geographic points and hydraulic parameters on one of the profiles could be correlated with the corresponding geographic points on the others. Strong interrelationships were found for the Red River between river sinuosity and valley slope. A smooth longitudinal river profile was maintained, in spite of irregularities in the valley or regional slope, by changes in sinuosity. A channel pattern alternation between braided and non-braided was found to be associated with changes in water surface slope. A new function was developed, herein called the meander function, which was found to be correlated with channel pattern and slope. Although the paper was confined to the Red River, the techniques used can be applied to any river. (Sims-ISWS)
W78-01146

SIMULATION OF THE INLET HYDROGRAPH FOR URBAN CATCHMENTS,

Institute of Hydrology, Wallingford (England).

C. H. R. Kidd, and P. R. Hellier.

Journal of Hydrology, Vol 35, No 1/2, p 159-172, October 1977. 4 fig, 4 tab, 12 ref.

Descriptors: *Urban hydrology, *Urban runoff, *Model studies, Mathematical models, Urban drainage, Hydrographs, Simulation analysis, Drainage, Watersheds(Basins), Rainfall, Precipitation(Atmospheric), Surface drainage, Surface runoff, Discharge(Water), Urbanization, On-site investigations, Hydrology, Hydraulics.

Identifiers: *Southampton (England).

A single nonlinear reservoir model was proposed as a realistic routing method for the above-ground phase of urban runoff. The use of the model was demonstrated on data collected from 2 very small (less than 1 ha) suburban catchments instrumented for this purpose. The shape of observed hydrographs was modelled satisfactorily using a non-linear exponent of 2/3 and fitted routing constants. (Sims-ISWS)
W78-01147

A STUDY INTO THE LOW-FLOW CHARACTERISTICS OF BRITISH RIVERS,

Institute of Hydrology, Wallingford (England).

M. A. Beran, and A. Gustard.

Journal of Hydrology, Vol 35, No 1/2, p 147-157, October 1977. 6 fig, 10 ref.

Descriptors: *Low flow, *Runoff, *Watersheds(Basins), Rainfall, Precipitation(Atmospheric), Low-flow frequency, Streamflow, Reservoirs, Storage, Regression analysis, Rivers, Streams, Flow, Data processing, Hydrology.

Identifiers: Error analysis.

Investigations are described currently being undertaken at the Institute of Hydrology into methods for predicting low flows from catchment characteristics. Different sources of errors in flow data were described. The sources were all taken into account when selecting suitable flow records for analysis. A number of analytical techniques which incorporate both the magnitude and duration of low flows were described, and some of their areas of application were given. Preliminary results highlight the need for careful screening of the data, the significance of mean annual rainfall, and the need for a geology index. Catchment characteristics used in the study were outlined, together with their effect on low flows. The regression analyses to be used in developing formulas for predicting the low flow indices from catchment and climate characteristics is discussed. (Sims-ISWS)
W78-01148

Field 2—WATER CYCLE

Group 2E—Streamflow and Runoff

OBSERVED MIXING LENGTHS IN MOUNTAIN STREAMS

Geological Survey of Canada, Ottawa (Ontario).
T. J. Day.

Journal of Hydrology, Vol 35, No 1/2, p 125-136, October 1977. 4 fig, 2 tab, 11 ref.

Descriptors: *Mixing, *Streams, *Mountains, Turbulence, Tracers, On-site investigations, Streamflow, Equations, Rivers, Roughness(Hydraulic), Velocity, hydraulics.

Identifiers: *Mixing lengths, *New Zealand.

Lateral mixing characteristics were investigated from a series of 41 dilution gaugings (slug injections) in five mountain streams (New Zealand). Data were presented which showed that mixing lengths for either center or side injections can be determined from the simple proportion, $x / \text{sub m}$ is approximately equal to $25 w$ (where $x / \text{sub m}$ is the mixing length and w the mean flow width). Observed mixing lengths were shown to be generally shorter than those predicted by conventional formulas. It also was shown that side injections do not require longer mixing lengths. Both the shorter mixing lengths and the lack of sensitivity to injection position is probably the result of increased turbulent and mechanical mixing associated with large roughness elements distributed along the flow boundary. (Sims-ISWS)

W78-01150

2F. Groundwater

GASS ON GAS,

National Water Well Association, Worthington, OH.

T. E. Gass.

Water Well Journal, Vol 31, No 11, p 34-35, November, 1977.

Descriptors: *Groundwater, *Water wells, *Carbon dioxide, *Gases, Groundwater movement, Pressure head, Drawdown.

Many explanations have been offered for the occurrence of entrained gas in well water. The most probable of these describes the phenomenon in terms of chemical equilibrium. As ground water moves slowly through the subsurface environment, it dissolves many solids and gases. Any change in pressure, temperature, or chemical surroundings can alter the chemical equilibrium of underground water, changing its capacity to hold dissolved materials. As water is pumped from a well, the pressure differential that is created upsets the equilibrium, causing dissolved carbon dioxide to be released as gas bubbles. As the velocity of ground water increases, hydraulic head decreases which further contributes to the release of gas. Because entrained gas can lead to cavitation and damage to pumps, it is desirable to minimize the release of gas in the water being pumped. This can be accomplished by designing well systems so that velocity of water entering the well screen is low (0.1 ft/sec. or less) and drawdown is minimal. (Eberle-NWWA)

W78-00956

EFFECTS OF AQUIFER THICKNESS AND SIDE PERFORATION ON DISCHARGE FROM OPEN WELL,

Indian Inst. of Tech., Kharagpur.

A. P. Mishra, and T. P. Ojha.

Irrigation and Power, Vol 33, No 2, p 225-235, April, 1976. 10 fig, 5 tab, 5 ref.

Descriptors: *Aquifers, *Irrigation wells, *Discharge(Water), Flow, Groundwater movement, Well construction.

Ground water is the most vital and dependable source of supply for irrigation in India. When the open wells commonly used there are constructed by brick masonry, the side walls are impervious;

most of these wells get their supplies from the first water-bearing formation encountered and do not receive sufficient discharge to support irrigation pumping equipment. Moreover, in cases of limited thickness of aquifer, the flow pattern gets disturbed and the prediction of discharge by previously developed formulas may not be reliable. Effects of aquifer thickness and of perforations in well walls on discharge in open wells are described. Laboratory simulation of field conditions was used to determine the mathematical relationships presented. (Eberle-NWWA)

W78-00962

MATHEMATICAL MODELING OF NATURAL GROUNDWATER RECHARGE,

Utah International Inc., San Francisco, CA. Environmental Quality Dept.

N. Krishnamurthi, D. K. Sunada, and R. A.

Longenbaugh.

Water Resources Research, Vol. 13, No. 4, p 720-724, August 1977. 4 fig, 15 ref. OWRT A-16-COL02.

Descriptors: *Groundwater recharge, *Model studies, *Mathematical models, Soil water, Soil moisture, Capillary action, Pore pressure, Infiltration, Computer models.

A mathematical model was presented which determines natural groundwater recharge by using transient soil moisture data measured as a function of vertical position. The model was based upon the finite difference form of the Richards equation. The assumption was made that moisture content varies in the linear range of pressure-moisture and conductivity-moisture relations to obtain a solution to a particular field problem. The parameters of the model, estimated by a linear model of the moisture data, characterize the hydraulic properties of soil and their spatial variability. The finite difference form of the mathematical model was solved by iteration using the Newtonlike method, ensuring computational speed and accuracy. The model and the computer program were verified by using the first-order, approximate, one-dimensional solution of the infiltration equation for homogeneous soil. Application of the model to the High Plains of Colorado provided monthly recharge rates which correlate adequately with the time series data of water table elevations and events of precipitation and ephemeral streamflow. (Sims-ISWS)

W78-00974

HYDROGEOLOGICAL ASPECTS OF THE RICHARDS BAY AREA, SOUTH AFRICA,

National Physical Research Lab., Pretoria (South Africa).

P. F. Worthington.

South African Journal of Science, Vol 71, p 375-377, December 1975. 5 fig, 7 ref.

Descriptors: Aquifers, Groundwater recharge, Subsurface flow, Hydrogeology, Geophysics, Potable water, Water resources, Water supply, Geological surveys, Freshwater lakes, Groundwater basins, Permeable strata, Geoelectrical methods, Limestones, Water table, Groundwater resources evaluation.

Identifiers: South Africa, Richards Bay, Lake Mzingazi, Natal, Miocene.

Lake Mzingazi will suffice as the primary local source of potable water for Richards Bay over the next few years. A detailed program of geophysical and hydrogeological investigations within a surrounding area of about 100 km² is being carried out, with the major object of determining quantitatively the mechanism of sub-surface replenishment of the lake, through the distribution of permeable strata. A preliminary appraisal of the results is given. (So. African Water Info. Center.)

W78-00998

ELECTRICAL RESISTIVITY FOR ESTIMATING PERMEABILITY,

Rhode Island Univ., Kingston. Dept. of Civil and Environmental Engineering.

W. E. Kelly.

Journal of the Geotechnical Engineering Division, American Society of Civil Engineers, Vol. 103, No. GT10, p 1165-1169, October 1977. 2 fig, 1 tab, 11 ref, 1 append. NSF GK-42130.

Descriptors: *Permeability, *Resistivity, *Aquifers, Groundwater, Electrical properties, Resistance, Electrical resistance, Aquifer testing, Electrodes, Correlation analysis, Pumping, Wells, Water wells, Hydrogeology.

The purpose of this note was to demonstrate that relations between aquifer resistivities determined from electric resistivity soundings and aquifer permeability can be developed. The approach should be useful for applications to shallow aquifers. During surface resistivity measurements in the field, electrical current may be made to follow approximately the same paths that water flowing to a well at that point would follow. In this way, the flow of electricity may be assumed to be subject to the same averaging process to which water flowing to a well is subject. As a first approximation, an electrical sounding with its center located over a potential well site would be appropriate; beneath the center of the array, current flow would be approximately horizontal, as would water flowing to a well. Also, comparable volumes of material may be sampled by the electrical resistivity measurements and by the pumping well. (Sims-ISWS)

W78-01010

A PRELIMINARY APPRAISAL OF THE GARBER-WELLINGTON AQUIFER, SOUTHERN LOGAN AND NORTHERN OKLAHOMA COUNTIES, OKLAHOMA,

Geological Survey, Oklahoma City, OK. Water Resources Div.

For primary bibliographic entry see Field 7C.

W78-01075

THICKNESS OF THE POTABLE-WATER ZONE IN THE FLORIDAN AQUIFER,

Geological Survey, Jacksonville, FL. Water Resources Div.

L. V. Causey, and G. W. Leve.

Florida Bureau of Geology Map Series No 74, 1976. 1 sheet, 8 ref.

Descriptors: *Groundwater resources, *Aquifer characteristics, *Potable water, *Subsurface mapping, *Florida, Water yield, Water quality, Potentiometric level, Aquifers, Depth.

Identifiers: *Floridan aquifer, *Potable-water zone thickness.

The Floridan aquifer, which is present throughout Florida, yields potable water only in central, west-central, and northern parts of the State. There is little or no potable water available from the aquifer in southern Florida and along the east-central coastal area. Potable water as referred to in the report contains 250 milligrams per liter or less of chloride or sulfate. Generally, if potable water is available in the aquifer it will be in the upper part. The top of the Floridan aquifer, which is composed of limestone and dolomite beds, ranges from more than 100 feet above sea level in west-central and north-central parts of the State to more than 1,000 feet below sea level in the southeastern and southwestern parts. A map shows the approximate thickness of the zone of potable water in the Floridan aquifer in Florida. The maximum thickness exceeds 2,000 feet in the central part of the State. From there, it thins to less than 250 feet in east-central, south-central, and west-central parts of the State. The thickness generally exceeds 500 feet in most of northern Florida and is as much as 1,750 feet thick in the northeastern part. (Woodard-USGS)

W78-01081

WATER CYCLE—Field 2
Water In Soils—Group 2G

GROUND-WATER RESOURCES OF THE LOWER SANTIAM RIVER BASIN, MIDDLE WILAMETTE VALLEY, OREGON.
Geological Survey, Sacramento, CA. Water Resources Div.; and Geological Survey, Portland, OR. Water Resources Div.
For primary bibliographic entry see Field 4B.
W78-01084

RECONNAISSANCE OF GROUND-WATER RESOURCES IN A PART OF THE YAMPA RIVER BASIN BETWEEN CRAIG AND STEAM-BOAT SPRINGS, MOFFAT AND ROUTT COUNTIES, COLORADO.
Geological Survey, Lakewood, CO. Water Resources Div.
R. E. Brodgen, and T. F. Giles.
Water-Resources Investigations 77-4 (open-file report), May 1977. 1 sheet, 2 tab, 7 ref.

Descriptors: *Groundwater resources, *Aquifers, *Water yield, *Water quality, *Maps, Hydrogeology, Colorado, Aquifer characteristics, Water demand, Water utilization, Available water, Water analysis, Chemical analysis.
Identifiers: *Yampa River basin(Colo), *Moffat and Routt Counties(Colo).

Parts of the Yampa River basin near the towns of Steamboat Springs and Craig, Colo., have undergone rapid population growth in recent years. Aquifers in the study area include: alluvium; the Browns Park, Wasatch, Fort Union, Lance, Williams Fork, and Iles Formations; and the Lewis and Mancos Shales. Well yields are generally less than 25 gpm (gallons per minute). In the alluvium of the Yampa River, well yields may be as much as 900 gpm. Where the sandstones of the Williams Fork and Iles Formations are fractured, well yields have been reported to be as much as 100 gpm. Well yields from the Lewis and Mancos Shales are less than 5 gpm. The quality of the ground water is variable and dependent on rock type. Most of the waters are calcium and sodium bicarbonate types. Calcium sulfate type waters are found where water in the aquifer has been in contact with gypsum, organic materials, or coals. Dissolved-solids concentrations of ground water range from as little as 82 to as much as 4,230 milligrams per liter. (Woodard-USGS)
W78-01086

MAPS SHOWING GROUND-WATER CONDITIONS IN THE SOUTHERN PART OF THE CHINLE AREA, APACHE COUNTY, ARIZONA-1976.
Geological Survey, Tucson, AZ. Water Resources Div.
For primary bibliographic entry see Field 7C.
W78-01087

GROUND-WATER LEVELS AND DESCRIPTIONS OF OBSERVATION WELLS IN IDAHO, 1975.
Geological Survey, Boise, ID. Water Resources Div.
H. G. Sisco.
Idaho Department of Water Resources Water Information Bulletin No 43, December 1976. 314 p., 17 fig., 40 ref.

Descriptors: *Idaho, *Observation wells, *Water levels, *Basic data collections, *Aquifers, Geology, Water level fluctuations, Water utilization.

Ground-water-level data for the 1975 calendar year consist of well descriptions, water-level measurements, and well-location maps for all observation wells in Idaho maintained by the U.S. Geological Survey. The development of Idaho's ground-water resources has expanded at a very rapid rate in recent years. A large part of the agricultural water supply, as well as most municipal, industrial, and domestic supplies, is derived from wells. Use of ground water has been accompanied by a

decline of local and, in some cases, regional ground-water levels. The director of the Idaho Department of Water Resources has the responsibility of administering and investigating the ground-water resources of the State so that orderly and optimum development of the resource can be attained. For this report, the State has been divided into seven areas. Well data are arranged alphabetically by county within each area. (Woodard-USGS)
W78-01089

SUMMARY OF GROUND-WATER CONDITIONS IN THE JAFFNA PENINSULA, REPUBLIC OF SRI LANKA, WITH A PLAN FOR INVESTIGATING THE FEASIBILITY OF GROUND-WATER DEVELOPMENT,
Geological Survey, Trenton, NJ. Water Resources Div.

For primary bibliographic entry see Field 4B.
W78-01093

2G. Water In Soils

METHYLATION OF MERCURY IN A TERRESTRIAL ENVIRONMENT,
Environmental Monitoring and Support Lab., Las Vegas, NV.

For primary bibliographic entry see Field 5B.
W78-00926

THE INFLUENCE OF CERTAIN CULTIVATION PRACTICES ON THE GROWTH AND PRODUCTION OF ZEA MAYS IN MARGINAL AREAS (IN AFRIKAANS),
Orange Free State Univ., Bloemfontein (South Africa).

For primary bibliographic entry see Field 3F.
W78-00947

THE EFFECT OF SEASONAL GRAZING ON THE INFILTRATION CAPACITY OF SOILS IN A CYMBOPOGON-THEMEDA VELD (IN AFRIKAANS),
Orange Free State Univ., Bloemfontein (South Africa).

J. A. Van den Berg, B. R. Roberts, and L. F. Vorster.

Proceedings of the Grassland Society of Southern Africa, Vol. 11, p 91-95, 1976. 3 fig, 2 tab, 28 ref. (English summary).

Descriptors: Rainfall, Seasonal, *Infiltration, *Grazing, Soil properties, *Porosity, *Permeability, Runoff, Soil moisture, Soil-water-plant relationships, Soil compaction, Veld.
Identifiers: South Africa.

The long term effects of grazing during fixed seasons and combinations of the seasons, on the infiltration capacity of soils in a Cymbopogon-Themeda veld in the Central Orange Free State were investigated. Two field experiments were grazed by Merino sheep and Afrikaner cattle respectively. Each experiment was a 2(4) factorial layout with grazing and resting as treatments. All possible combinations of spring, summer, autumn and winter served as the 16 treatments. The infiltration measurements were determined by means of a flood type concentric ring infiltrometer. The results showed that grazing during any one of the seasons reduced the infiltration capacity of the soils. The detrimental effects of summer and autumn grazing were, however, larger than those of winter and spring grazing. Highly significant positive correlations between infiltration capacity and veld condition, as measured in terms of the basal cover of climax grasses, were obtained. (So. African Water Info. Center)
W78-00949

PROTECTION OF A UNIQUE ECOLOGICAL AREA THROUGH IMPROVED WATER AND FERTILITY MANAGEMENT,
Nebraska Univ., Lincoln. Dept. of Agricultural Engineering.

P. E. Fischbach.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-274 399. Price codes: A09 in paper copy, A01 in microfiche. University of Nebraska Water Resources Center, Completion Report, October 2, 1977. 187 p., 68 fig., 43 tab., 7 ref., 4 append. OWRT B-024-NEB(1), 14-31-0001-4101.

Descriptors: *Water management(Applied), *Soil properties, Model studies, *Nitrogen, Irrigation, *Water utilization, *Nitrates, Sands, Corn(Field), *Leaching, Soil water, Moisture deficit, Evapotranspiration, Percolation, Rainfall, Fertilizers, *Fertilization, *Nebraska, Crop production, Soil-water-plant relationships.

Research was conducted to define practices for managing water and nitrogen fertilizer in the production of irrigated corn on sandy soils. The objective was to increase the efficiency of use of the water resource while minimizing the leaching of nitrate nitrogen from the crop root zone to the groundwater system. On the sandy soils which were studied, experiments showed that it is not necessary to completely replenish the soil water deficit at each irrigation. Near maximum yields were obtained when water application was limited to an amount equivalent to .76 cm per day, approximately 60% of the peak evapotranspiration rate. Stored soil water and rainfall supplemented irrigation application. Percolation loss was minimized by this technique. An irrigation frequency of 3.5 days during July and August produced greater yields than did frequencies of 1.5 or 7 days. Research indicated that the present farmer practice of applying 250 kg/ha of nitrogen and completely replenishing the soil water deficit at each irrigation may result in nitrate leaching losses of 30 to 45 kg/ha during the growing season, depending on rainfall amount.
W78-01001

ELECTRICAL RESISTIVITY FOR ESTIMATING PERMEABILITY,
Rhode Island Univ., Kingston. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 2F.
W78-01010

WATER AND CHLORIDE MOVEMENT THROUGH SOIL COLUMNS SIMULATING PEDAL SOILS,
Wisconsin Univ., Madison. Dept. of Soil Science. J. Bouma, and J. L. Anderson.
Soil Science Society of America Journal, Vol. 41, No. 4, p 766-770, July-August 1977. 6 fig, 4 tab, 17 ref. EPA R802874.

Descriptors: *Soil water movement, *Soils, *Laboratory tests, Soil water, Tracers, Chlorides, Dispersion, Infiltration, Hydraulic conductivity, Pores, Porosity, Saturated flow, Unsaturated flow, Soil physics, Soil science.
Identifiers: Miscible displacement, Soil microstructure.

Interpretation of dispersion phenomena in soils is complicated by many complex interactions within the highly heterogeneous pore system. Model experiments were designed, therefore, to investigate the specific effects of hydrodynamic dispersion of (1) vertically continuous macropores in different types of microstructure, and (2) different flow regimes. Two homogeneous microstructures were formed by mixing, puddling, and drying of sand and silty clay loam materials to sandy loam and clay loam textures. Small vertically continuous cylindrical pores were made in 30-cm long columns that had a diameter of 10 cm to simulate macropores. Breakthrough curves, following a

Field 2—WATER CYCLE

Group 2G—Water In Soils

daily 0.5-cm application of chloride solution, showed that identical macropores have different hydraulic functions in different soil materials. The intermittent flow resulted in much better displacement of untraced water in the more permeable sandy loam columns, but 'immobile' water remained in both soils. Dispersion phenomena in both microstructures (which represented two 'ideal' textural porosities) differed significantly when saturated flow was compared with flow through a crust. Implications for the physical interpretation of soil structure descriptions were discussed. (Sims-ISWS)
W78-01011

AIR REGIME OF NONIRRIGATED AND IRRIGATED CISCAUCASIAN CHERNOZEMS,
Moscow State Univ. (USSR). Dept. of Soil Science.
For primary bibliographic entry see Field 3F.
W78-01049

MICROWAVE REMOTE SENSING OF SOIL WATER CONTENT.
Kansas Univ./Center for Research, Inc., Lawrence. Remote Sensing Lab.
J. Cihlar, and F. T. Ulaby.
Available from the National Technical Information Service, Springfield, VA 22161 as N76-12446. Price codes: A09 in paper copy, A01 in microfiche. Technical Report 264-6, August 1975. 196 p, 70 fig, 17 tab, 125 ref, 2 append. NAS 9-14052.

Descriptors: *Remote sensing, *Soil moisture, *Microwaves, Moisture content, Model studies, Water balance, Soil temperature, Simulation analysis, Depth, Estimating, Profiles, Air-earth interfaces, Algorithms, Diurnal, Wavelengths, Computer programs, Infrared, Monitoring.

Two types of techniques appear potentially capable of providing location-specific soil water content information, namely water balance and remote sensing methods. Using a layered water balance model and a soil temperature simulation model, moisture and temperature profiles of a hypothetical soil located at mid-latitudes were generated, analyzed, and subsequently used for computing microwave soil parameters at three frequencies (1.4, 4.0, and 10.0 GHz) for a clear-sky summer day. The results suggest that: (1) soil moisture in the top 30 cm can be predicted on a daily basis for 1-cm depth increments within approximately 0.02 cu cm/cm, (2) soil temperature presents no problem in microwave remote sensing of soil moisture provided that surface soil temperature can be measured with infrared radiometers from the same platform, and (3) surface layer domination exists, i.e., remotely measured microwave response of a bare soil is determined primarily by the moisture at and near the surface unless appreciable air-soil discontinuities (in terms of wavelength) exist within the soil. An algorithm was proposed which combines the water balance and microwave methods to monitor profile soil water content content changes over large areas. A summary of passive and active microwave measurements of soil moisture was presented. (Visocky-ISWS)
W78-01056

DETECTION OF SOIL MOISTURE AND SOIL CHARACTERISTICS FROM SKYLAB,
Kansas Univ./Center for Research, Inc., Lawrence. Space Technology Center.
For primary bibliographic entry see Field 7B.
W78-01058

SOLUTE TRANSFER, WITH EXCHANGE BETWEEN MOBILE AND STAGNANT WATER, THROUGH UNSATURATED SAND,
Centre National de la Recherche Scientifique, Paris (France).
J. P. Gaudet, H. Jegat, G. Vachaud, and P. J. Wierenga.

Soil Science Society of America Journal, Vol. 41, No. 4, p 665-671, July-August 1977. 6 fig, 2 tab, 22 ref.

Descriptors: *Solute, *Transfer, *Ion exchange, Unsaturated flow, Diffusion, Soils, Salinity, Depth, Leaching, Laboratory tests, Numerical analysis, Mathematical models, Equations, Stagnant water, Calcium chloride.

Identifiers: Miscible displacement, Unsaturated soil.

Changes in salt concentration with time were measured at several depths inside and at the exit of a 94-cm uniform unsaturated sand column which was leached at steady rates with solutions of calcium chloride. Observed salt distributions were compared with salt distributions calculated with a numerical procedure which was based on the dead-end pore model of Coats and Smith (1964). Values for the dispersion coefficient, the diffusional mass transfer coefficient, and the fraction mobile water used in the model were obtained at different water contents by curve fitting observed and calculated concentrations at one depth. The same values then were used to calculate salt distributions at other depths and at the exit of the column and were compared with measured salt distributions. Excellent agreement was obtained. The model presented a good description of the extensive tailing of the salt concentration distributions observed inside and at the exit of the column. The amount of stagnant water was found to increase with decreasing water content from 4% of the total water content of 0.256 cu cm/cm to 0.200 cu cm/cm. The apparent dispersion coefficient decreased from 6 sq cm/hour to 1 sq cm/hour at water contents of 0.256 and 0.200 cu cm/cm, respectively. (Sims-ISWS)
W78-01065

DEPRESSED WEIR WITH TWO UNEQUAL SHEETPILES IN ANISOTROPIC SOIL,
Indian Inst. of Science, Bangalore. Dept. of Civil Engineering.
A. S. Reddy, and U. Basu.
Journal of Hydrology, Vol 35, No 1/2, p 61-72, October 1977. 6 fig, 11 ref.

Descriptors: *Weirs, *Seepage, *Sheet piling, Model studies, Mathematical models, Flow, Porous media, Permeability, Anisotropy, Soil, Soil water movement, Flow, Engineering structures, Hydraulic structures, Soil properties, Soil physics. Identifiers: *Flow under a weir.

An analytical solution was presented, making use of the Schwartz-Christoffel transformation, for determining the seepage characteristics for the problem of flow under a weir having two unequal sheetpiles at the ends and embedded in an anisotropic porous medium of finite thickness. Results for several particular cases of simple hydraulic structures can be obtained from the general solution presented. Numerical results in nondimensional form were given for quantity of seepage and exit gradient distribution for various conditions in the equivalent transformed isotropic section; and, by making use of the physical parameters in the actual anisotropic plane and the set of transformation relations given, the quantities (seepage loss, exit gradient) can be interpreted in the actual anisotropic physical plane. (Sims-ISWS)
W78-01151

2H. Lakes

PHYTOPLANKTON, PHYTOPLANKTON GROWTH AND BIOMASS CYCLES IN AN UNPOLLUTED AND IN A POLLUTED POLAR LAKE,
For primary bibliographic entry see Field 5C.
W78-00920

EFFECTS OF BURROWING TUBIFICID WORMS ON THE EXCHANGE OF PHOSPHORUS BETWEEN LAKE SEDIMENT AND OVERLYING WATER,
For primary bibliographic entry see Field 5C.
W78-00921

A QUANTITATIVE SAMPLER FOR AQUATIC MACROPHYTES,
Natal Univ., Pietermaritzburg (South Africa). Dept. of Botany.
For primary bibliographic entry see Field 7B.
W78-00929

DISTRIBUTION OF ORGANIC MATTER IN LAKE BAIKAL SEDIMENTS (OB OSOBOENNOSTYAH RASPREDELENIYA ORGANICHESKOGO VESHCHESTVA V OSAD-KAKH BAIKAL),
Limnologicheskii Inst., Irkutsk (USSR). L. A. Vykhristyuk.
Doklady Akademii Nauk Belorusskoi SSSR, Vol. 205, No. 6, p 1455-1457, 1972. 1 fig, 14 ref.

Descriptors: *Organic matter, *Bottom sediments, *Lakes, Nitrogen, Carbon, Marine plants, Estuaries, Lakes, Bottom sediments, Lake sediments, Aquatic life, Benthos.

Identifiers: *Lake Baikal(USSR).

Analyses of the organic carbon and nitrogen contents and determinations of the carbon/nitrogen ratios in various part of Lake Baikal, including river estuaries, were made during the period 1966-1968. Analyzed was the upper layer of the bottom sediments, and a diagram is presented showing the points of sample collection. The contents of carbon and nitrogen and their ratio are discussed in relation to the flora and fauna of the lake, and the contribution of the rivers to the formation of the sediments. (Stapinski-IPC)
W78-00981

HYDROGEOLOGICAL ASPECTS OF THE RICHARDS BAY AREA, SOUTH AFRICA,
National Physical Research Lab., Pretoria (South Africa). For primary bibliographic entry see Field 2F.
W78-00998

LAKE ST. LUCIA: MATHEMATICAL MODELLING AND EVALUATIONS OF AMELIORATIVE MEASURES,
University of the Witwatersrand, Johannesburg (South Africa) Hydrological Research Unit. I. P. Hutchison, and W. Pitman.
The Civil Engineer in South Africa, Vol. 19, No. 4, p 75-82, 1977. 13 fig, 4 ref.

Descriptors: *Mathematical modelling, Ameliorative measures, Estuaries, Salinity, Ecology, Water level fluctuations, *Saline lakes, Salt marshes, Primary production, Rainfall, Salt balance, *Saline water-freshwater interfaces, *Environmental effects, *Remedies.

Identifiers: Lake St. Lucia, Mkuzi River, Msinene River, Lhluhluwe River, Nyalazi River, Mpate River, Natal, South Africa.

Connected to the sea by a narrow estuary, St. Lucia lake is a shallow, generally saline water body situated on the sub-tropical east coast of northern Natal. The lake constitutes an internationally renowned nature reserve rich in freshwater and marine flora and fauna. With the advent of man, development of the catchments of the rivers feeding the lake has disturbed the delicate balance between the freshwater supply and evaporation losses. To an ever-increasing degree the system has now to rely on salt water from the sea to replace the water lost by evaporation. Consequently, during drought, salinities may rise to several times that of sea water, with dire consequences to the flora and fauna. Work was aimed

WATER CYCLE—Field 2

Lakes—Group 2H

primarily at establishing the effect of man's activities on the water level and the salinity regimes in the lake and, secondly at selecting and testing feasible engineering measures aimed at preserving or enhancing the nature reserve environment. No attempt is made, however, to perform a benefit-cost analysis of the lake system as a whole. The development of a set of interlinked mathematical models for simulating the water level and salinity regimes of the system is described. These models are employed to evaluate the effectiveness of a variety of possible remedial measures. (So. Africa Water Info Center) W78-0106

JUVENILE FISH POPULATIONS IN THE MARGINAL AREAS OF LAKE MCILWAINE, RHODESIA,
Department of National Parks and Wildlife Management, Norton (Rhodesia).
B. E. Marshall, and C. A. Lockett.
Journal of the Limnological Society of Southern Africa, Vol. 2, No. 2, p 37-42, 1976, 6 fig, 2 tab, 15 ref.

Descriptors: Fish populations, Poisoning, Species abundance, Growth rate, Lakes, Fish production, Eutrophication.
Identifiers: Lake McIlwaine, Rhodesia, Southern Africa.

Lake McIlwaine is an artificial lake situated about 37 km to the southwest of Salisbury, Rhodesia. It has become eutrophic through the addition of sewage effluent and now supports a large population of blue-green algae and primary production is high. As a result there has been an increase in fish production and the lake supports a commercial fishery as well as being an important angling center. A program of fish poisoning using a rotenone derivative was carried out at five stations in Lake McIlwaine during 1974/75. It was hoped to estimate standing crop and population size by this means but this was not entirely successful. However data on the population of juvenile fish in the shallow, marginal waters were obtained and 17 of the 25 species known to occur in the lake were recorded. Species composition varied considerably and some species such as *Hydrocynus vittatus* and *Alestes imberi* which were known to be common were not recorded in large numbers. Standing crop estimates varied considerably; fish movement in response to temperature variations was a factor that accounted for much of this. Length-frequency distributions were plotted for the five most abundant species and an indication of their growth rates was obtained. (So. African Water Info. Center) W78-0107

EUTROPHICATION OF LAKES,
Institute for Water and Air Pollution Research, Stockholm (Sweden).
For primary bibliographic entry see Field 5C. W78-0120

AN ANALYSIS OF DRAG COEFFICIENT AT HURRICANE WINDSPEEDS FROM A NUMERICAL SIMULATION OF DYNAMICAL WATER LEVEL CHANGES IN LAKE OKEECHOBEE, FLORIDA,
Texas A and M Univ., College Station. Dept. of Oceanography.
R. E. Whitaker, R. O. Reid, and A. C. Vastano.
Available from the National Technical Information Service, Springfield, VA 22161 as ADA023 683, Price codes: A06 in paper copy, A01 in microfiche. Technical Memorandum No. 56, Coastal Engineering Research Center, Fort Belvoir, Virginia, October 1975. 104 p, 63 fig, 2 tab, 44 ref. Army DACW 72-71-C-0011.

Descriptors: *Drag, *Storm surge, *Lakes, *Florida, *Model studies, Mathematical models, Hurricanes, Winds, Storms, Waves(Water), Water

levels, Seiches, Surges, Wind tides, Surface waters, Marshes, Freshwater marshes.
Identifiers: *Lake Okeechobee(Fla), Drag coefficient.

A time-dependent, two-dimensional storm surge algorithm was used to estimate the drag coefficient, C sub D, over the windspeed range: W sub 10 = 20 to 40 meters per second, where W sub 10 is the windspeed 10 meters above MWL. The algorithm represents a vertically integrated physical model which includes nonlinear boundary conditions representing flooding and recession. Wind and water level data for the investigation were gathered by the U.S. Army Engineer District, Jacksonville, in the Lake Okeechobee, Florida, region. The lake is a roughly circular feature 60 kilometers in diameter with a maximum normal depth of 4 meters. The effect of extensively grassed, shallow areas of the lake on wind-driven circulation was simulated by a multilayer canopy flow model and included as a subroutine in the numerical analog. The surge model was calibrated for empirical constants with two seiches and quasi-static wind-induced condition within the lake. Two wind-stress relationships, a quadratic one and the Keulegan-Van Dorn expression, were used to model the air-sea interaction. Multiple surge calculations were performed with a range of C sub D, and statistical analyses were made of the difference between the observed and computed water levels for the hurricane of August 1949. The results indicated that the Keulegan-Van Dorn wind-stress model yields superior results over the windspeed range. This conclusion was verified by a simulation of the surge associated with the hurricane of October 1950. (Sims-ISWS) W78-0103

SHORT-TERM TRANSIENT VARIATIONS OF LIMNOLOGICAL PARAMETERS IN GRAND TRAVERSE BAY, LAKE MICHIGAN,
Michigan Univ., Ann Arbor. Sea Grant Program.
A. H. Vogel, J. J. Sygo, T. M. Kelly, R. P. Canale, and H. E. Allen.
Journal of Great Lakes Research, Vol. 2, No. 1, p 193-205, July 1976. 11 fig, 4 tab, 18 ref. NOAA 04-6-158-4408.

Descriptors: *Water quality, *Bays, *Lake Michigan, *Variability, Primary productivity, Chlorophyll, Nutrients, Dissolved oxygen, Conductivity, Hydrogen ion concentration, Temperature, Water temperature, Alkalinity, Light penetration, Biomass, Zooplankton, Surveys, Diurnal distribution, Storms, Weather, Limnology.

Throughout the period 30 July - 3 August 1973, measurements of primary production, chlorophyll a, dissolved and particulate nutrients, dissolved oxygen, conductivity, pH, temperature, alkalinity, light penetration, and zooplankton biomass were taken at 2 to 4 hour intervals at an anchor station in Grand Traverse Bay, Lake Michigan. Determinations were made at the water surface, and at 1, 2, 3, 5, 10, 15, 20, 35, and 50 meters. Diurnal changes were observed in temperature, dissolved oxygen, chlorophyll a, primary production, and zooplankton in the top 2 meters. Storm-induced changes were found for temperature, dissolved oxygen, silica, dissolved phosphorus, chlorophyll a, and primary production. The storm-induced changes were considerably greater than the diurnal changes for those parameters that responded to both causal agents. No significant changes were found for conductivity, pH, total phosphorus, or nitrate. Ammonia concentrations were too low to permit statistical analysis. (Sims-ISWS) W78-0103

SEDIMENT DISTRIBUTION AND BOTTOM TOPOGRAPHY OF SOUTHEASTERN LAKE SUPERIOR,
Department of the Environment, Burlington (Ontario). Inland Waters Branch.
For primary bibliographic entry see Field 2J.

W78-01034

MULTIPLE ESTIMATES OF LAKE ERIE EVAPORATION,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
For primary bibliographic entry see Field 2D. W78-01035

WATER QUALITY STUDIES OF SIXTEEN MINNESOTA RIVERS TRIBUTARY TO LAKE SUPERIOR,
Reserve Mining Co., Silver Bay, MN.
For primary bibliographic entry see Field 5A. W78-01036

DISTRIBUTION OF WATER MASSES IN AND NEAR THE STRAITS OF MACKINAC,
Michigan Univ., Ann Arbor. Great Lakes Research Div.
R. A. Moll, C. L. Schelske, and M. S. Simmons.
Journal of Great Lakes Research, Vol. 2, No. 1, p 43-59, July 1976. 11 fig, 4 tab, 18 ref. EPA R-802721.

Descriptors: *Water quality, *Surveys, *Lake Michigan, *Lake Huron, *Great Lakes, Sampling, Data processing, Silica, Nitrates, Phosphorus, Chlorophyll, Hydrogen ion concentration, Water temperature, Conductance, Secchi disks, Analytical techniques, Statistics, Correlation analysis, Limnology, Water analysis.
Identifiers: *Straits of Mackinac.

Three cruises in the Straits of Mackinac area were conducted from 30 August to 8 October 1973. Samples were taken from up to 11 depths during each cruise and were analyzed for silica, nitrate, total and soluble phosphorus, chlorophyll a, pH, water temperature, and specific conductance. Cluster analyses were used to visualize the relationship between stations for each depth on all cruises. The clearest relationships observed were from 0, 5, and 10 m depths, while clusters of data from other depths were not as useful in describing water masses. Analyses of 0-10 m depths showed a consistent homogeneous water mass extending through the northern edge of the Straits proper, past the western edge of Mackinac Island, to south of Bois Blanc Island. The cluster of stations was found during most wind conditions at the 3 depths considered. The last cruise, 6-8 October, occurred during a period of light winds from the southeast which partially disrupted this cluster. Relationships between the variables were defined by factor analysis which showed silica and nitrate increased with decreasing water temperature and pH, and partly as a function of depth. Secchi disc values tended to vary independently of most other variables, implying that these readings had little value in explaining water quality in the Straits region. (Sims-ISWS) W78-01038

IFYGL SHIPBOARD VISUAL WAVE OBSERVATIONS VS WAVE MEASUREMENTS,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
P. C. Liu, and T. A. Kessenich.
Journal of Great Lakes Research, Vol. 2, No. 1, p 33-42, July 1976. 9 fig, 7 ref.

Descriptors: *Waves(Water), *Lake Ontario, *Great Lakes, On-site investigations, Limnology.
Identifiers: *International Field Year for the Great Lakes, Data comparisons, Wave height, Wave periods, Shipboard observations, Wave measurements.

Data used for this study were collected in Lake Ontario during 1972, the International Field Year for the Great Lakes (IFYGL). Shipboard me-

Field 2—WATER CYCLE

Group 2H—Lakes

terological observations, which included visual estimates of wave height and wave period, were made in the Great Lakes by over 100 ships from the United States and Canada. Data collected from the ship reports covered a wide range of lake conditions and, hence, provide a useful basis for climatological studies of surface waves in the Great Lakes. The objective of this paper was to present an assessment of the reliability of the ship reports. Records from deep water wave gauges were compared with shipboard observations made within 50 km of the gauges. The results showed that visually estimated wave heights, $H_{\text{sub vo}}$, and wave periods, $T_{\text{sub vo}}$, were correlated with the recorded significant wave heights, $H_{\text{sub s}}$, and average zero-crossing wave periods, $T_{\text{sub z}}$, respectively by $H_{\text{sub s}} = (0.25 + 0.6 H_{\text{sub vo}})$ meters and $T_{\text{sub z}} = (2.0 + 0.2 T_{\text{sub vo}})$ seconds. Visual observations appeared to substantially underestimate the steepness of the waves. Long-term distributions for wave heights and wave periods followed the log-normal distribution quite closely. The results generally were similar to those of oceanic studies. (Sims-ISWS) W78-01049

RESULTS FROM A NUMERICAL MODEL FOR SIMULATING CIRCULATION PATTERNS AND CHLORINITY DISTRIBUTIONS IN SAGINAW BAY

Argonne National Lab., IL.

J. H. Allender, and A. W. Green.

Journal of Great Lakes Research, Vol. 2, No. 1, p 7-12, July 1976. 4 fig, 8 ref. NOAA 04-3-158-23.

Descriptors: *Water circulation, *Bays, *Salinity, *Lake Huron, *Great Lakes, Circulation, Winds, Seiches, Lakes, Chlorine, Distribution patterns, Diffusion, Advection, Model studies, Mathematical models, Pollutants, Path of pollutants, Water pollution, Limnology.

Identifiers: *Saginaw Bay.

Circulation and advection-diffusion of chlorine in Saginaw Bay were simulated in a detailed manner over real time periods as great as one month by using an alternating-direction-implicit (ADI) integration procedure. External forcing was based on interpolated time histories of wind records and on open boundary data inferred from spectral analyses of water level records. Average simulated circulation under prevailing southwesterly winds was compared with yearly-averaged observational data at 5 sites in the bay. Excellent agreement between the directions of observed and computed currents was found, except near the open boundary adjoining Lake Huron. Reasons for the disparity were discussed. The response of the chlorine distribution to the time-dependent wind also was compared to the response to the mean wind over the same period. (Sims-ISWS) W78-01078

FREE MODE COUPLING OF SAGINAW BAY AND LAKE HURON

Argonne National Lab., IL.

J. H. Allender, and A. W. Green.

Journal of Great Lakes Research, Vol. 2, No. 1, p 1-6, July 1976. 6 fig, 1 tab, 6 ref. NOAA 04-3-158-23.

Descriptors: *Lake Huron, *Great Lakes, *Water levels, *Seiches, Time series analysis, Bays, Lakes, Circulation, Water circulation, Limnology, Waves(Water).

Identifiers: *Saginaw Bay, Water level spectra, Cross spectral calculations, Longitudinal modes.

Time series analyses were made of water level records from 4 stations within and outside of Saginaw Bay. Coherence squares computed from the series showed that the 2nd, 3rd, and 6th longitudinal modes of the bay are coupled strongly with the 3rd, 5th, and 6th longitudinal modes of Lake Huron. Cross spectra provided estimates of phase differences for the coupled modes at the

various stations. The complexity of the spectra increases significantly due to the presence of many non-longitudinal seiches during periods when the mean wind exceeds approximately 3.5 m/sec. (Sims-ISWS) W78-01041

LIMNOLOGICAL DATA REPORT FOR THE MAINE DEPARTMENT OF ENVIRONMENTAL PROTECTION — U.S. GEOLOGICAL SURVEY COOPERATIVE LAKE STUDIES PROJECT

Geological Survey, Augusta, ME. Water Resources Div.; and Maine Dept. of Environmental Protection, Augusta, Div. of Lakes and Biological Studies.

D. J. Cowing, and M. Scott.

Geological Survey open-file report, March 1977. 145 p, 1 fig, 3 tab, 20 ref.

Descriptors: *Lakes, *Limnology, *Maine, *Biological properties, *Chemical properties, Lake morphology, Epilimnion, Tributaries, Lake basins, Hydrologic data, Data collections, Water analysis, Aquatic bacteria, Microorganisms, Benthic fauna.

The report contains physical, chemical, and biological information collected on 43 lakes in Maine. Methods of collection and analysis of the hydrologic data are outlined. Physical characteristics listed include drainage area, surface area, surface elevation, volume, maximum depth, mean depth, epilimnion depth, epilimnion volume, and length of shoreline. As many as 27 parameters are listed for lake sample sites and 5 for tributaries. Biological analyses include phytoplankton data for 2 of the study lakes, zooplankton data for 3, benthic macroinvertebrate data for 22, and bacterial data for lake tributaries. (Woodard-USGS) W78-01088

LAKES OF OREGON: VOLUME 5. MARION COUNTY

Geological Survey, Portland, OR. Water Resources Div.

J. F. Rinella.

Open-file report, 1977. 99 p, 4 fig, 2 tab, 27 ref.

Descriptors: *Lakes, *Oregon, *Investigations, *Hydrologic data, *Water quality, Drainage area, Elevation, Volume, Lake morphology, Lake morphometry, Inflow, Discharge(Water), Water utilization, Aerial photography, Bathymetry, Mapping.

Identifiers: *Marion County lakes(Oreg).

An inventory of lakes and reservoirs of Oregon is essential for a complete evaluation of the total surface-water supply of the State and a basis for answering questions about Oregon's lakes. The lake information is being issued in several volumes on a county or multicounty basis. This report, volume 5, includes hydrologic, physical, and water quality data for 115 lakes in Marion County. In general, any lake with a surface area greater than 5 acres is included in this inventory, but a few smaller bodies are also included. Natural ephemeral lakes are not included nor are manmade ponds several acres in size that are used solely for stock water. (Woodard-USGS) W78-01080

A HYDROLOGIC DESCRIPTION OF KEYSTONE LAKE NEAR TAMPA, FLORIDA

Geological Survey, Tampa, FL. Water Resources Div.

R. C. Reichenbaugh.

Water-Resources Investigations 76-124 (open-file report), 1977. 1 sheet, 14 fig, 1 tab, 10 ref.

Descriptors: *Lake basins, *Lake stages, *Lake morphology, *Hydrologic data, *Florida, Water quality, Rainfall, Streamflow, Runoff, Inflow, Surface-groundwater relationships, Lakes, Water levels, Water table, Hydrogeology, Maps, Aerial photography.

Identifiers: *Tampa area(Florida), *Keystone Lake, Brooker Creek, Cosme well field, Floridan aquifer.

The terrain around Keystone Lake, a 388-acre lake in northwest Hillsborough County, Florida, near the Cosme well field, is dotted with sinks that promote leakage from the surficial aquifer to the underlying Floridan aquifer. The lake, an integral part of the Brooker Creek channel, receives overland runoff from cypress swamps, pastures, citrus groves, and lakefront residential areas. The lake, a composite of many coalescing sinkholes, is generally 14 to 16 ft deep and has been dredged in places to 23 ft deep. Since 1960, rainfall in the area shows a cumulative negative departure of 86 in. from the long-term average. The mean annual lake stage in 1973 was the lowest on record. Concurrently, municipal pumping in the Cosme well field from the Floridan aquifer peaked in 1961 and again in 1973, and in 1972 the potentiometric surface was the lowest since 1960. Comparisons of the hydrographs of lake stage and the potentiometric surface in the Floridan aquifer with rainfall graphs shows that both correspond closely to seasonal rainfall, resulting in the trend of decreasing seasonal maximum levels in the lake and the aquifer. Keystone Lake water quality is adequate for recreation and propagation of wildlife. (Woodard-USGS) W78-01088

EFFECTS OF URBAN LAKES ON SURFACE RUNOFF AND WATER QUALITY

Wisconsin Univ.-Milwaukee. Dept. of Geological Sciences.

For primary bibliographic entry see Field 2E.

W78-01135

COMPARISON OF MODEL AND OBSERVED CURRENTS IN LAKE MICHIGAN

Argonne National Lab., IL.

J. H. Allender.

Journal of Physical Oceanography, Vol. 7, No. 5, p 711-718, September 1977. 4 fig, 3 tab, 16 ref.

Descriptors: *Currents(Water), *Lake Michigan, *Model studies, *Mathematical models, Lakes, Circulation, Water circulation, On-site investigations, Measurement, Winds, Temperature, Current meters, Limnology.

Results from four deterministic numerical-hydrodynamical models for Lake Michigan were compared to data from the field program of the Federal Water Pollution Control Agency (FWPCA) for September 1963, and to other limited data from which lake currents can be inferred. Fourier norms and average angle statistics show that model and observed currents as fixed locations do not compare well. Comparability does not improve when near-inertial motions are removed or when motions having periods up to 72 h are removed. This lack of agreement is practically unavoidable and results primarily from inadequate knowledge of the wind field and probably from the grid scale used in the models. Qualitative agreement between the model and FWPCA currents was seen in lake-wide plots of several day average motion. Surface currents inferred from satellite imagery were grossly similar to model currents under the appropriate, average wind conditions. (Sims-ISWS) W78-01140

THE TIME-DEPENDENT RESPONSE OF A CIRCULAR BASIN OF VARIABLE DEPTH TO A WIND STRESS

Northwestern Univ., Evanston, IL. Dept. of Engineering Sciences; and Northwestern Univ., Evanston, IL. Dept. of Geological Sciences.

G. E. Birchfield, and B. P. Hickie.

Journal of Physical Oceanography, Vol. 7, No. 5, p 691-701, September 1977. 5 fig, 2 tab, 14 ref, 1 append. NSF GA-25442, NOAA 04-4-022-37.

Descriptors: *Lakes, *Water circulation, *Great Lakes, *Lake Ontario, Winds, Wind tides, Circulation, Currents(Water), Waves(Water), Model studies, Mathematical models, Seiches, Topography, Limnology.

Identifiers: Barotropic response.

By solving an initial value problem, the time-dependent response of a large circular model lake to a steady wind stress was investigated. Bottom stress was neglected. The forced response was divided naturally into a 'seiche' response and a quasi-geostrophic 'current' response; the former was composed of gravity and topographic waves, the latter topographic waves only. The forced quasi-geostrophic response, consisting of coastal jets and return flow, slowly rotates cyclonically around the basin. The model was compared with forced barotropic response observed in Lake Ontario. (Sims-ISWS)

W78-01141

MICROBIOLOGICAL PROCESSES IN THE MEROMICTIC LAKE VALLE DE SAN JUAN IN CUBA (IN RUSSIAN),

V. I. Romanenko, M. Peres Eiris, V. M. Kudryavtsev, and M. Aurora Pubienas.

Mikrobiologiya 45(3): 539-546. 1976. (English summary).

Descriptors: *Meromictic lakes, *Cuba, *Mixolimnion, Microbiology, Pelodictyon phaeum, Sulfur bacteria.

The lake was studied in April and July of 1973. Gleothecae prevailed in the mixolimnion and the green sulfur bacterium Pelodictyon phaeum in the layer of pink water down to 10 m. The production of photosynthetic sulfur bacteria comprises 3% of the production of algae. Sulfate reduction takes place mainly in water beyond the layer of sulfur bacteria. The content of H₂S in the monolimnion is 104 mg/l. Bacteria utilize 40% of the H₂S produced. Three maxima in bacterial content were: at a depth of 7 m; in the layer of pink water, at a depth of 10 m; and at the bottom. Total mineralization and electroconductance of water at the bottom are higher by a factor of 6 than those at the surface. Destruction of organic substance is a little higher than production.—Copyright 1977, Biological Abstracts, Inc.

W78-01180

21. Water In Plants

USES OF PHRAGMITES AUSTRALIS (IN AFRIKAANS),

Agricultural Research Inst., Middleburg (South Africa).

For primary bibliographic entry see Field 4A.

W78-00933

SOME OBSERVED INTERRELATIONSHIPS BETWEEN THE COVER OF AQUATIC VEGETATION AND VARIOUS PHYSICAL PROPERTIES OF THE WATER MEDIUM, Botanical Research Unit, Durban (South Africa). C. F. Musil, C. H. Borman, and J. O. Grunow. Journal of South African Botany, Vol 42, No 2, p 157-169. 1976. 7 fig, 4 tab, 3 ref.

Descriptors: *Aquatic plants, *Hydrogen ion concentration, *Water temperature, Turbidity, Aquatic weeds.

Identifiers: Pongolo River, Potamogeton crispus, Nymphaea lotus, Najas pectinata, Pistia stratiotes, Ludwigia stolonifera, Eichornia, Scirpus.

High pH and oxygen but low total carbon dioxide values were recorded from water at sites containing high percentage covers of predominantly submerged aquatic vegetation. The converse was true in water at sites containing very dense covers of

predominantly rooted-floating and free floating aquatic vegetation. The cover of submerged aquatic vegetation was influenced by the turbidity of the water and also by shading, particularly by that of floating aquatic vegetation. (So. African Water Info. Center)

W78-00941

THE INFLUENCE OF FERTILIZER-APPLIED CHLORINE, CHLORINE CONTENT OF IRRIGATION WATER AND LEACHING OF CHLORINE ON THE UPTAKE OF CHLORINE BY TOBACCO (IN AFRIKAANS),

Tobacco Research Inst., Rustenburg (South Africa).

For primary bibliographic entry see Field 3F.

W78-00943

THE ROLE OF WATER NUTRITION AND YIELD LEVEL IN THE GRAIN-STALK RATIO OF MAIZE (IN AFRIKAANS),

Pretoria Univ. (South Africa). Dept. of Plant Production.

For primary bibliographic entry see Field 3F.

W78-00946

THE PERIODS SENSITIVE TO INTERNAL PLANT MOISTURE STRESS DURING GROWTH AND DEVELOPMENT OF ZEA MAYS (IN AFRIKAANS),

Orange Free State Univ., Bloemfontein (South Africa).

For primary bibliographic entry see Field 3F.

W78-00948

STUDY OF THE INFLUENCE OF SOIL DROUGHT AND HIGH AIR TEMPERATURE ON SOME PHYSIOLOGICAL PROCESSES IN MAIZE PLANT (IN SERBO-CROATIAN),

Institut Kukuruz, Zemun (Yugoslavia).

B. Kerecki, L. Zaric, D. Jelenic, and M. Pencic. Acta Bot Croat 35: 113-118. 1976. (English summary).

Descriptors: *Corn, *Drought, Humidity, Transpiration, Plant physiology, Stress.

Crop injuries, which occur often in Yugoslavian climatic conditions during the growing period, are due to high temperatures accompanied with relatively low air humidity. Heat stress effects the greatest damage on the plant during fertilization. An experiment was carried out with the maize hybrid, ZP 755, in the 8th phase of tassel development. The plants were grown in an open greenhouse in Mitcherlich pots, on soil whose moisture contents was 30%-70% of the maximum water capacity. Heat stress was provoked in the heat stress chamber with temperatures of 44-46 C, relative air humidity of 26% and wind velocity of 9/m/min. Water fractions, intensity of transpiration, and concentration of cell liquid were determined in the leaves of plants exposed to the heat stress, while N fractions were determined in leaf, stalk and root. Drought and heat stress cause considerable changes in all water and N fractions. The amount of bound water in treated plants increases while the amount of free water decreases. At the same time soluble and non-protein N is increased and total N decreased in relation to the control.—Copyright 1977, Biological Abstracts, Inc.

W78-01018

EFFECT OF WATER STRESS ON PROLINE SYNTHESIS FROM RADIOACTIVE PRECURSORS,

Iowa State Univ. Ames. Dept. of Botany and Plant Pathology.

S. F. Boggess, C. R. Stewart, D. Aspinall, and L. G. Paleg.

Plant Physiology, Vol. 58, No. 3, p 398-401, September, 1976, 4 fig, 20 ref.

Descriptors: *Radioactivity effects, *Moisture stress, *Wilting, *Leaves, *Amino acids, Isotopes, Carbon compounds, Radioactivity, Moisture content, Moisture deficit, Bermudagrass, Barley, Chromatography.

Identifiers: *Proline.

Although several plants have been reported to accumulate free proline during periods of water deficit or when subjected to other stress, the biochemical changes linking water stress and proline accumulation are not well understood. Experiments were conducted using radioactive isotopes to explore this relationship in greater detail. The results are presented. Barley leaves converted more 14 Carbon glutamic acid to free proline when water stressed than when turgid; neither decreased protein synthesis nor isotope trapping by the enlarged free proline pools found in wilted tissues seemed to account for the result. This apparent stimulation of proline biosynthesis in wilted leaves was not observed when radioactive ornithine or PSC were used as proline precursors unless proline levels were high as a result of previous water stress. This is interpreted to mean that any stimulation of proline synthesis by water stress must act on PSC formation rather than its reduction to proline. (Jamail-Arizona)

W78-01042

INDICES OF PLANT WATER STATUS: SOME COMPARISONS WITHIN AND BETWEEN CROP SPECIES,

Commonwealth Scientific and Industrial Research Organization, Aspendale (Australia). Div. of Atmospheric Physics. W. Shepherd.

The Journal of Applied Ecology, Vol 13, No 1, p 205-209, April, 1976, 2 fig, 9 ref.

Descriptors: *Leaves, *Drought resistance, *Drought tolerance, *Moisture, Stress, Crop production, Plant growth, Droughts, Barley, Wheat, Potatoes, Canopy, Moisture content, Irrigation effects, Osmotic pressure, Drying, Plant physiology, Stomata, Diffusion, Plant tissues.

Identifiers: Sap osmotic potential, Leaf water potential.

The effects of plant water status on physiological processes have been widely studied using four indices of plant moisture, ratio of plant water content to dry weight, sap osmotic potential, leaf water potential, and leaf water vapor resistance. Relationships between the various indices are complex, but are important because of their relevance to crop growth modelling, studies of water movement in plants, and the resistance of plants to drought. Some relationships between the indices and transpiration have already been reported. This paper considers further data from potato, barley, and wheat crops, giving particular consideration to differences between crops grown under conditions of plentiful and limited water supply. The four indices were determined for the upper third of the canopy, and for the lower part, the remainder of the leaves. The results are presented. The relationships were different for upper and lower levels of plants, and different crop species, grown under various water regimes. Crops raised with a limited water supply developed in ways that tend to restrict transpiration during subsequent periods of drought. (Jamail-Arizona)

W78-01050

STRUCTURE OF THE EPIDERMAL AND SUB-EPIDERMAL CELLS OF SOME DESERT PLANTS OF ISRAEL, ANABASIS ARTICULATA AND CALLIGONUM COMOSUM,

Royal Veterinary and Agriculture Coll., Copenhagen (Denmark). Dept. of Plant Physiology and Anatomy.

O. B. Lyschede.

Israel Journal of Botany, Vol 26, p 1-10, 1977, 8 fig, 1 tab, 26 ref.

Field 2—WATER CYCLE

Group 21—Water in Plants

Descriptors: *Plant morphology, *Plant tissues, *Desert plants, Drought tolerance, Drought resistance, Epidermis, Water vapor, Arid lands, Absorption, Xerophytes, Dehydration, Photosynthesis, Hysteresis, Cellulose, Deserts.

Identifiers: Israel, Wax, Stems, Anabasis, Caligonomus.

The structure of the epidermal cell walls of the assimilating stem of *Anabasis articulata* and *Caligonomus comosus* were investigated. Due to their peculiar structure and specialized assimilating tissue, the epidermal cell walls swell rapidly during water absorption but when dehydrated release water very slowly. The structure and function of the epidermis and hypodermis in relation to the inner tissues are discussed from an ecological point of view. (Ullery-Arizona)

W78-01053

RATE OF LEAF PRODUCTION AND SENESCENCE AND EFFECT OF LEAF AGE ON NET GAS EXCHANGE IN CREOSOTEBUSH, New Mexico State Univ., University Park. Dept. of Biology.

J. P. Syvertsen, and G. L. Cunningham. *Photosynthetica (Prague)*, Vol 11, No 2, p 161-166, 1977, 1 tab, 18 ref.

Descriptors: *Growth rates, *Desert plants, *Plant physiology, *Photosynthesis, *Respiration, Carbon dioxide, Leaves, Transpiration, Arid lands, Growth chambers, Plant growth, Southwest US, Stomata, Shrubs.

Identifiers: Leaf senescence, Abscission, *Creosotebush, *Larrea tridentata*.

Creosotebush (*Larrea tridentata* DC. Cov.) is one of the most widespread and successful evergreen species of the warm desert regions of North America. One of the gaps in the knowledge of factors and processes associated with production of creosotebush is what determines senescence and in which manner net photosynthesis and dark respiration are affected by leaf senescence. Research was undertaken to ascertain if the rate of leaf senescence and subsequent abscission could be increased by increasing the rate of new leaf production and to determine the relationship between leaf age and gas exchange capacity. The results are presented. In growth chamber grown plants of creosotebush, the dark respiration, net photosynthesis, internal leaf resistance and stomatal and cuticular resistances to water and carbon dioxide were not affected by leaf age. Net photosynthesis did appear to be reduced in leaves older than 47 days. An increase in the apparent rate of leaf senescence and subsequent abscission coincide chronologically with an increase in the rate of new leaf production. (Jamail-Arizona)

W78-01054

2J. Erosion and Sedimentation

EFFECTS OF BURROWING TUBIFICID WORMS ON THE EXCHANGE OF PHOSPHORUS BETWEEN LAKE SEDIMENT AND OVERLYING WATER, For primary bibliographic entry see Field 5C.

W78-00921

MECHANICS OF SUSPENDED SEDIMENT IN RANDOM WAVES, Delaware Univ., Newark. Dept. of Civil Engineering; and Delaware Univ., Newark. Coll. of Marine Studies. For primary bibliographic entry see Field 2L.

W78-00980

POSSIBLE EFFECT OF SEDIMENTS AND CHANNEL PROCESSES ON RUNOFF REDISTRIBUTION IN A RIVER DELTA, S. S. Baydin.

Soviet Hydrology, Selected Papers, No 4, p 234-242, 1975. 3 fig, 1 tab, 26 ref. Translated from Trudy Gosudarstvennogo Okeanograficheskogo Instituta, No 118, p 116-135, 1974.

Descriptors: *Deltas, *Channel morphology, *Rivers, Sediments, Sedimentation, Erosion, Bed load, Sediment transport, Meanders, Alluvial channels, Coasts, Beds, Braiding, Channels, Streams, Discharge(Water), Runoff, Flood plains, Geomorphology.

Identifiers: *USSR.

All channel forms in the mouths of rivers are associated with types of bedload transport produced by the energy of the flow. Therefore, when investigating channel processes one should proceed from the energy characteristics of flow and the types of bedload movements and not from the forms of channel formations and geomorphological relations. In this case, the initial data must include: flow, the particle size of bottom deposits and sediment concentration, the slope of the land (valley) and its ratio to the slope of the water surface, and the ratio between the water slope during the flood and low-flow periods. A stream with a high flow energy does not meander and selects the shortest and straightest direction. Sediment transport is achieved in these reaches in the smooth stage during flood rise and in the structural bottom stage during flood recession and the low-flow period. With a decrease in slope and when flow energy is inconsistent with the particle size of the sediment, the flow can successively concentrate its energy in individual reaches, periodically moving the sediments from one reach to the other in the course of the year. The main types of structural sediment movement are: ribbon dune (riffle), midstream bar and side bar; and of structureless movement, continuous traction and sliding. (Sims-ISWS)

W78-01029

THRESHOLD OF SEDIMENT MOTION UNDER UNIDIRECTIONAL CURRENTS, Oregon State Univ., Corvallis. School of Oceanography.

M. C. Miller, I. N. McCave, and P. D. Komar. *Sedimentology*, Vol. 24, No. 4, p 507-527, August 1977. 9 fig, 1 tab, 50 ref. NASA NSG-7178.

Descriptors: *Sedimentation, *Reviews, *Data collections, *Laboratory tests, Sediment transport, Movement, Sediments, Analysis, Analytical techniques, Flow characteristics, Equations, Wind erosion, Water flow, Erosion, Flow, Cohesionless soils, Open channels, Flumes, Particle size.

Identifiers: Incipient motion.

Carefully selected data for the threshold of sediment movement under unidirectional flow conditions were utilized to re-examine the various empirical curves that are commonly employed to predict the threshold. After a review of the existing data, the only data used were obtained from laboratory open channel flumes with parallel sidewalls where flows were uniform and steady over flattened beds of ungranular, rounded sediments. Without the restrictions, an unmanageable amount of scatter is introduced. The selected data were used to develop a modified Shields-type threshold diagram that extends the limits of the original diagram by 3 orders of magnitude in the grain-Reynolds number. The equally general but more easily employed Yalin diagram for sediment threshold also was examined. Although the Shields and Yalin diagrams are general in that they apply to a wide range of different liquids, in both cases somewhat different curves were obtained for threshold under air than for the liquids. The often used empirical curves of the friction velocity, the velocity 100 cm above the bed, the bottom stress, and Shields' relative stress, all versus the grain diameter, are limited in their ranges of application to certain combinations of grain density, fluid density, fluid viscosity, and gravity. The conditions must be selected before the curves are generated

from either the more general Shields or Yalin curves. For example, on the basis of the data selected, empirical threshold relationships for quartz density material in water were tabulated. The limitations on any of the threshold relationships are severe. The limitations should be understood properly so that the empirical curves and relationships are not employed improperly. (Humphreys-ISWS)

W78-01030

SEDIMENT DISTRIBUTION AND BOTTOM TOPOGRAPHY OF SOUTHEASTERN LAKE SUPERIOR, Department of the Environment, Burlington (Ontario). Inland Waters Branch.

C. I. Dell.

Journal of Great Lakes Research, Vol. 2, No. 1, p 164-176, July 1976. 11 fig, 18 ref.

Descriptors: *Sediments, *Topography, *Lake Superior, Surveys, Geomorphology, Spatial distribution, Sediment distribution, Lakes, Sediment sorting, Sedimentation, Limnology, Sampling, Soundings.

Identifiers: *Eastern Lake Superior.

Sediment distribution in the complex region of troughs and shoals in southeastern Lake Superior was studied by means of echo sounding, coring, and surface sediment sampling. The primary factor governing sediment type is water depth with sediment source, water movement, trough morphology, and lake history superimposed upon it. Thick accumulations of fine-grained sediment are confined to the trough bottoms, whereas coarser sediments occur on the sides and crests. In the southern part of the region, subaqueous erosion of red tills leads to the deposition of brown gray sandy sediments whereas farther offshore dark gray fine-grained sediments show the influence of eroding varved clays. Current action along the south shore and along the trough bottoms produces sediment sorting even in deep water. On slopes greater than 1 or 2 degrees, fine-grained postglacial sediment is very thin or absent, and lag deposits overlie glacial sediments. Evidence of ice scour indicates that modifications to sediment distribution may have occurred during the low level Houghton stage about 8000 B.P. Stratigraphic evidence suggests that the most probable origin of the complex bottom topography is erosion by moving ice. (Sims-ISWS)

W78-01034

RAINWATER AND SEDIMENT RUNOFF FROM SLOPES IN THE AZOV-KUBAN PLAIN, Akademiya Nauk SSSR, Leningrad. Inst. Ozerovedeniya.

I. S. Boyko, and M. P. Zarin.

Soviet Soil Science, Vol. 8, No. 1, p 71-73, January-February, 1976, 1 tab.

Descriptors: *Runoff, *Rainfall-runoff relationships, *Slope protection, Rainfall, Sediments, Slopes, Slope stability, Erosion, Erosion rates, Precipitation(Atmospheric), Floods, Hydraulic structures, Impact(Rainfall), Rain, Erosion control.

Identifiers: U.S.S.R.

Study of the formation of runoff from slopes in the slightly hilly relief of the Ciscaucasian steppe is not only the scientific interest, but also of great practical importance. The characteristics of rainwater and sediment runoff from this area were investigated. Surface runoff and sediments were measured and the results presented. Water runoff increases from flood to flood, regardless of the magnitude of the runoff-forming rain and runoff depth. This is attributable to the deterioration of the infiltration characteristics of the soil because of the increase in the water content of its upper horizon and the silting of interaggregate pores. The field data obtained indicate that under certain conditions heavy rains may cause considerable ero-

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sion in plowed areas, even on very gentle slopes. This must be taken into account in planning hydraulic installations and in various kinds of erosion control practices in plowed areas. (Jamaill-Arizona)
W78-01046

EROSION AND TRANSPORT OF BED-LOAD SEDIMENT,

Technische Hogeschool, Delft (Netherlands).

R. F. Luque.

Available from the National Technical Information Service, Springfield, VA 22161 as N75-27298, Price codes: A06 in paper copy, A01 in microfiche. Ph.D. Thesis, 1974, 111 p. 21 fig, 6 tab, 32 ref.

Descriptors: *Bed load, *Erosion, *Sediment transport, *Deposition(Sediments), Saltation, Sands, Gravels, Hydraulics, Equations, Mathematical studies, Laboratory tests, Scour.

Identifiers: *Mean critical shear stress, *Nonceasing scour, Average particle velocity, Shield grain-movement condition, Magnetite grain, Walnut grain, Bulk erosion.

Results were presented of a series of experiments in which were measured: the mean critical bed shear stress at SHIELDS' grain-movement condition and at the initiation of non-ceasing scour, the rate of bedload transport, the average particle velocity, the rate of deposition, and the average length of individual steps of saltating bed-load particles, in water, as a function of the time-mean bed shear stress. These experiments were performed in a closed rectangular flow channel at different slopes of the bed surface and using five different bed materials (two sands, gravel, magnetite and walnut grains). A comparison of the threshold drag acting at different downward slopes of the bed surface (0, 12, 18 and 22 degrees) resulted in a surprisingly large critical-drag angle of 47 degrees. The initiation of non-ceasing scour of a loose granular bed was studied experimentally behind a consolidated bed of the same material as the loose bed. The corresponding instantaneous threshold drag was about three times larger than the threshold drag acting at SHIELDS' grain movement condition. The rate of bed-load transport measured as a function of the mean bed-shear stress satisfied a generalized MEYER-PETER and MULLER formula (1948), also at various downward slopes of the bed surface, as investigated up to 22 degrees. The rate of particle deposition was proportional to the rate of bed-load transport, and the average length of individual particle steps was a constant. This implied that the probability of a bed-load particle being deposited when striking the bed surface is independent of the flow rate within the experimental range. (See also W76-12827) (Lee-ISWS)
W78-01060

CALCIUM CARBONATES IN SUSPENDED DEPOSITS OF RIVERS AND IRRIGATION SYSTEMS IN CENTRAL ASIA (IN RUSSIAN),

Akademiya Nauk SSSR, Moscow. Inst. Geografii. N. T. Kuznetsov.

Pochvovedenie 7. 104-109. 1976. (English summary).

Descriptors: *Calcium carbonate, *Dissolved solids, *Rivers, Salts, Suspended solids, Irrigation systems, River basins.

Identifiers: Asia, Central Asia, USSR.

The migration of CaCO_3 in suspended deposits of rivers in the mountainous river basins in Middle Asia (USSR) is mostly due to geological conditions. Downstream the distributions of calcium carbonates in suspended deposits is primarily determined by weathering crusts. As is generally known, the crusts of the same bioclimatic zone differ less from one another than the original rocks. Thus the content of CaCO_3 in suspended deposits of individual rivers and irrigation systems

is leveled downstream.—Copyright 1977, Biological Abstracts, Inc.
W78-01072

UMPQUA RIVER ENTRANCE, OREGON.

Army Engineer District, Vicksburg, MS. Committee on Tidal Hydraulics.

For primary bibliographic entry see Field 8B.
W78-01152

2K. Chemical Processes

DISSOLVED OXYGEN AND SATURATION IN AN ENVIRONMENT OF HIGH ORGANIC PRODUCTION (ETANG DE BERRE): ROLE OF HALOCLINE ON DISTRIBUTION OF THESE AND ON THE OXYGEN-PHOSPHATE RATIO (IN FRENCH),

Centre Univ. de Luminy, Marseille (France). For primary bibliographic entry see Field 2L.
W78-00935

GASS ON GAS,

National Water Well Association, Worthington, OH.

For primary bibliographic entry see Field 2F.
W78-00956

SULFUR CONTENT OF SEDIMENTS OF THE MARIN ESTUARY AND OTHER GALICIAN ESTUARIES, (IN SPANISH),

A. Fernandez Del Riego.
Bol Inst Esp Oceanogr 215. 1-22. 1976.

Descriptors: *Sediments, *Sulfur, *Estuaries, Spain, Sulfates, Cellulose, Pulp wastes, Thiobacteria.

Because of the presence of wastes from a cellulose factory which used S compounds in wood processing, S pollution in the Marin estuary was studied. Sediments were collected in several estuaries (in Spain) and analyzed. S values were 2.3 for the Marin estuary, 3.9 for the Arosa estuary and 2.9 for the Muros estuary. There was no correlation between S content of sediments and the distance from the source of S wastes. The main source of S was dissolved sulfates, which are broken down by thiobacteria. The number of thiobacteria depends on the nature of the organic matter in the sediments. Although the addition of cellulose to sediments can increase the number of thiobacteria, cellulose is not as effective as some other organic materials such as dead plankton residues. Other factors causing variations in S were water depth, topography of the bottom and shoreline profile.—Copyright 1977, Biological Abstracts, Inc.
W78-00986

THE RIVER SKAWA: WATER CHEMISTRY AND EUTROPHICATION, (IN POLISH),

Polish Academy of Sciences, Warsaw. Dept. of Hydrobiology.

M. Bombowna.
Acta Hydrobiol 18(4): 407-420. 1976. (English Summary).

Descriptors: *Rivers, *Water levels, *Chlorophyll, Eutrophication, Algae, Skawa River.

Changes in the chemistry of the River Skawa (Poland) at various water levels were described 4 seasons of the year, special attention being paid to the fertility of the river on the basis of chlorophyll content. The water in the river basin of the Skawa, a tributary of the River Vistula, is of a carbonate-calcareous type. A corresponding decrease in the chlorophyll content in attached algae, depending to a great degree on their species composition, shows a negative correlation with the water level

in the river. The ratio of the chlorophyll content in the attached algae to that in the seston is a good index of productivity zones along the river course. The constant intensification of agriculture, with the present pollution of the river, brings about the eutrophication which has been advancing throughout the years and is manifested in the growing concentration of mineral nutrient compounds.—Copyright 1977 Biological Abstracts, Inc.
W78-00990

SOLUTE TRANSFER, WITH EXCHANGE BETWEEN MOBILE AND STAGNANT WATER, THROUGH UNSATURATED SAND,

Centre National de la Recherche Scientifique, Paris (France).

For primary bibliographic entry see Field 2G.
W78-01065

A PRELIMINARY APPRAISAL OF THE GARBER-WELLINGTON AQUIFER, SOUTHERN LOGAN AND NORTHERN OKLAHOMA COUNTIES, OKLAHOMA,

Geological Survey, Oklahoma City, OK. Water Resources Div.

For primary bibliographic entry see Field 7C.
W78-01075

HYDROLOGIC DATA FOR THE VAMOOSA AQUIFER, EAST-CENTRAL OKLAHOMA,

Geological Survey, Oklahoma City, OK. Water Resources Div.

For primary bibliographic entry see Field 2A.
W78-01076

MAPS SHOWING GROUND-WATER CONDITIONS IN THE SOUTHERN PART OF THE CHINLE AREA, APACHE COUNTY, ARIZONA-1976,

Geological Survey, Tucson, AZ. Water Resources Div.

For primary bibliographic entry see Field 7C.
W78-01087

2L. Estuaries

RELATIONSHIPS BETWEEN THE BIVALVE MACOMA BALTICA AND BACTERIA IN INTERTIDAL SEDIMENTS: MINAS BASIN, BAY OF FUNDY,

McMaster Univ., Hamilton (Ontario). Dept. of Geology.

For primary bibliographic entry see Field 5C.
W78-00905

DISSOLVED OXYGEN AND SATURATION IN AN ENVIRONMENT OF HIGH ORGANIC PRODUCTION (ETANG DE BERRE): ROLE OF HALOCLINE ON DISTRIBUTION OF THESE AND ON THE OXYGEN-PHOSPHATE RATIO (IN FRENCH),

Centre Univ. de Luminy, Marseille (France).

M. Minas.
Hydrobiologia 51(2): 149-162. 1976. (English Summary).

Descriptors: *Dissolved oxygen, *Lakes, Brackish water, Lake Etang de Berre, Nutrients, Phosphate.

The evolution of O₂ distribution (concentration and saturation) was monitored in brackish waters of the lake Etang de Berre during several years. In relation to the occurrence of a well-defined pycnocline (halocline) an oxycline is shown to be present, leading to anoxic conditions in some cases. The relationships between O₂ and nutrients under conditions of O₂ depletion are examined and it is shown that anomalies are due to the dynamic aspects of the consumption-production-regeneration system. A concept of the theoretical O₂ budget

Field 2—WATER CYCLE

Group 2L—Estuaries

in a brackish water basin is proposed. —Copyright 1977, Biological Abstracts, Inc.
W78-00935

DENSITY-INDUCED MOTIONS IN SHALLOW LAGOONS.

Rosenstiel School of Marine and Atmospheric Science, Miami, FL.
D. R. Johnson, and T. N. Lee.
Miami University Sea Grant Technical Bulletin No 38, August, 1977. 32 p, 6 fig, 4 ref, 2 append. SG-
No. 2-35147.

Descriptors: Density currents,
"Gradients(Streams), "Estuaries, "Lagoons,
"Flow characteristics, "Mathematical models,
Movement, Biscayne Bay, Card Sound(FLA).

Horizontal density gradients are often present in estuaries. These gradients exert a torque which can induce a flow that may aid in reducing the residence time. Using simple models, the influence of a horizontal density gradient on the residence time of a shallow, well-stirred lagoon was investigated. Under steady-state conditions and with scaling taken from the southeast Florida lagoons (Biscayne Bay and Card Sound), it was found that density-induced motions do not contribute substantially to flushing the lagoon waters. However, as an estuary's depth increases or, if the horizontal density gradient is large, density-induced flow can be significant. A graphic approach is presented which can be used to determine density-induced residence time from knowledge of the horizontal density gradient and the water depth. (NOAA)
W78-00978

A MECHANISM FOR RIP CURRENT GENERATION ON AN OPEN COAST,

Delaware Univ., Newark. Dept. of Civil Engineering; and Delaware Univ., Newark. Coll. of Marine Studies.
R. A. Dalrymple.
Journal of Geophysical Research, Vol. 80, No. 24, p 3485-3487, August 20, 1975. 1 fig, 1 tab, 20 ref.
ONR N00014-69-A-0407.

Descriptors: "Rip currents, "Waves(Water),
"Coasts, Currents(Water), Beaches, Seashores,
Model studies, Mathematical models, Laboratory tests,
Oceans, Ocean waves, Wavelengths, Water levels.
Identifiers: "Wave interactions, Longshore currents.

A mathematical model was developed which provides an explanation for the occurrence of longshore and rip currents on the open coast. This concept was verified by a small experiment done in a model basin. It was shown that intersecting ocean wave trains of the same frequency will create periodic longshore variations in the mean water level both inside and outside the surf zone. In the surf zone this creates a longshore variation in wave height and wave-induced circulation previously attributed to edge waves and irregular bottom topography. (Sims-ISWS)
W78-00976

ANALYSIS OF INHOMOGENEOUS WAVE NUMBER SPECTRA,

Delaware Univ., Newark.
M. A. Tayfun, C. Y. Yang, V. Klemas, and H. Wang.
Journal of Geophysical Research, Vol. 80, No. 24, p 3469-3474, August 20, 1975. 4 fig, 12 ref. ONR
N00014-69-A-0407.

Descriptors: "Ocean waves, "Shores, "Aerial photography,
"Analytical techniques, Wavelengths, Waves(Water), Shallow water, Heterogeneity, Beaches, Seashores, Oceanography.
Identifiers: "Wave spectra.

As waves propagate from deep to shallow water, various effects of the shallowing depth of water spatially modify spectral characteristics of the sea surface. In such spatially inhomogeneous regimes, spectral computations based on a finite field size are subject to errors due to an inherent spatial smoothing in addition to resolution errors of a more conventional nature. The conflicting requirements of resolution and smoothing errors for an accurate analysis prescribe an optimal field size for which the combined magnitude of such errors is minimal. The optimal field size, the associated errors in resolution and smoothing, and the conditions for limiting accuracy were derived for computations in a shallow water wave field in which refraction and shoaling constituted the predominant inhomogeneity effects. Bottom friction, percolation, and reflection were neglected, and calculations were based on a first-order approximate shallow water wave theory. (Sims-ISWS)
W78-00978

VORTEX GENERATION BY OSCILLATORY FLOW OVER RIPPLED SURFACES,

Naval Undersea Center, San Diego, CA.
E. B. Tunstall, and D. L. Inman.
Journal of Geophysical Research, Vol. 80, No. 24, p 3475-3484, August 20, 1975. 8 fig, 1 tab, 25 ref.

Descriptors: "Vortices, "Ripple marks,
"Waves(Water), "Energy dissipation, Laboratory tests, On-site investigations, Model studies, Flow, Energy loss, Beaches, Shores, Seashores, Sands, Dye releases, Tracking techniques.
Identifiers: "Oscillatory flow.

Vortices generated by oscillatory flow over symmetrical sand ripples were investigated in order to ascertain the amount of wave energy loss that can be attributed to the formation and movement of vortices. The experimental phase of the investigation centered around the flow visualization of the vortices over the ripples. These laboratory data were used to obtain values for three parameters (vortex size, circulation, and radius of the vortex core) needed to evaluate the amount of energy bound up in the vortex, the energy relationship being derived from a trapped vortex model. Comparison of the vortex kinetic energy loss attributed to bottom effects indicated that the vortices possess about 7% of the measured wave energy loss, the majority of the remaining energy loss being attributed to bottom shear. (Sims-ISWS)
W78-00979

MECHANICS OF SUSPENDED SEDIMENT IN RANDOM WAVES,

Delaware Univ., Newark. Dept. of Civil Engineering; and Delaware Univ., Newark. Coll. of Marine Studies.
H. Wang, and S. S. Liang.
Journal of Geophysical Research, Vol. 80, No. 24, p 3488-3494, August 20, 1975. 7 fig, 26 ref. ONR
N00014-69-A-0407.

Descriptors: "Sediments, "Suspended solids,
"Waves(Water), "Coasts, Suspended load, Beaches, Sediment transport, Mass transfer, Model studies, Mathematical models, Mechanical properties.
Identifiers: "Surf zone.

The mechanics of suspended sediment under wave action were investigated. The results applied to regions well beyond the surf zone where the flow field, though irregular in appearance, was still amenable to mathematical expressions in gross terms. The motion of the suspended sediment particle and that of the fluid particle in a wave field were found to have an amplitude difference and a phase lag. The suspended sediment concentration was hyperbolic trigonometric function of water depth. The relation reduced to a power law for shallow water cases. The value of power was found to be a function of particle settling velocity, fluid particle velocity, and wave number. Wave

mass transport velocity was derived on the basis of turbulent boundary layer as the lower boundary condition. Finally it was found that the rate of suspended sediment transport in a wind-generated random wave field can be approximated by a power function in terms of wind velocity. (Sims-ISWS)
W78-00980

SULFUR CONTENT OF SEDIMENTS OF THE MARIN ESTUARY AND OTHER GALICIAN ESTUARIES, (IN SPANISH),

For primary bibliographic entry see Field 2K.
W78-00986

DISTRIBUTION OF BENTHIC MACROFAUNA IN LANGEBAAN LAGOON,

Cape Town Univ. (South Africa). Dept. of Zoology.
N. D. Christie, and A. Moldan.
Transactions of the Royal Society of South Africa, Vol 42, No 3 and 4, p 273-284, May 1977. 3 fig, 6 tab, 24 ref.

Descriptors: Benthos, Marine animals, Macrofauna, Species distribution, Water depth, Saline marshes, Baseline studies, Sediment analysis, Food chains, Water temperature, Primary productivity, Sampling stations, Biomass, Salinity range, Ecosystem ecology, Marine ecosystems.
Identifiers: Langebaan Lagoon, Saldanha Bay, South Africa.

Fifteen stations were sampled in Langebaan Lagoon using a diver-operated suction sampler. The macrofauna was analysed using numerical methods, by the rarefaction technique, to define relative species richness and by ash-free dry-weight biomass determinations. Three basic groups were defined: the channel, island and sandbank groups. The channel and island groups had the greatest biomass and the highest species richness values respectively. In contrast the sandbank group had the lowest biomass values, intermediate species richness values and the highest density of individual animals per m². The availability of food, water current velocity and hence sediment texture, water temperatures and salinity apparently were most important factors in determining the distribution of the macrofauna. (So. African Water Info. Center).
W78-00999

LAKE ST. LUCIA: MATHEMATICAL MODELLING AND EVALUATIONS OF AMELIORATIVE MEASURES,

University of the Witwatersrand, Johannesburg (South Africa) Hydrological Research Unit.
For primary bibliographic entry see Field 2H.
W78-01006

OCEAN SURFACE CURRENTS MAPPED BY RADAR,

National Oceanic and Atmospheric Administration, Boulder, CO. Environmental Research Labs. D. E. Barrick, M. W. Evans, and B. L. Weber. Science, Vol. 198, No. 4313, p 138-144, October 14, 1977. 6 fig, 13 ref.

Descriptors: "Radar, "Ocean currents,
"Instrumentation, Equipment, Remote sensing, Coasts, Ocean waves, Currents(Water), Electronic equipment, Measurement, Mapping, Oceans, Oceanography.
Identifiers: "Surface currents.

A high frequency radar remote sensing system for measuring and mapping near surface ocean currents in coastal waters was analyzed and described. A transportable prototype version of the system was designed, constructed, and tested. With two units operating tens of kilometers apart, the currents were mapped in near real time at a grid of points 3 by 3 km covering areas exceeding

WATER SUPPLY AUGMENTATION AND CONSERVATION—Field 3

Conservation in Industry—Group 3E

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2000 sq km, out to a distance of about 70 km from the shore. Preliminary estimates of the precision of current velocity measurements show it to be better than 30 cm/sec. (Sims-ISWS)
W78-01133

ADVECTION IN THE PERU CURRENT AS OBSERVED BY SATELLITE.
Hawaii Univ., Honolulu, Dept. of Oceanography.
For primary bibliographic entry see Field 7B.
W78-01137

CENOZOIC EVOLUTION OF ANTARCTIC GLACIATION, THE CIRCUM-ANTARCTIC OCEAN, AND THEIR IMPACT ON GLOBAL PALEOCEANOGRAPHY,
Rhode Island Univ., Kingston. Graduate School of Oceanography.
J. P. Kennett.
Journal of Geophysical Research, Vol. 82, No. 27, p 3843-3860, September 20, 1977. 13 fig, 1 tab, 111 ref. NSF OPP75-15511.

Descriptors: *Antarctic, *Glaciation, *Ocean circulation, Cenozoic era, Paleoclimatology, Ice, Glaciers, Circulation, Oceans, Sediments, Cores, Core logging, Core drilling, Geology, Climatology, Oceanography.
Identifiers: *Paleoceanography, Paleoglaciation, Paleocirculation.

Deep-sea drilling in the Antarctic region has provided much new data about the development of circum-Antarctic circulation and the closely related glacial evolution of Antarctica. The Antarctic continent has been in a high latitude position since the middle to late Mesozoic. Glaciation commenced much later, in the middle Tertiary, demonstrating that near polar position is not sufficient for glacial development. Instead, continental glaciation developed as the present day Southern Ocean circulation system became established when obstructing land masses moved aside. (Sims-ISWS)
W78-01138

RESIDUAL FLOW AND BOUNDARY SHEAR STRESS IN THE TURBULENT BOTTOM LAYER BENEATH WAVES,
Reading Univ. (England). Dept. of Meteorology.
B. Johns.
Journal of Physical Oceanography, Vol. 7, No. 5, p 733-738, September 1977. 4 fig, 11 ref.

Descriptors: *Turbulent boundary layers, *Waves(Water), *Model studies, Mathematical models, Numerical analysis, Flow, Roughness(Hydraulic), Shear stress, Friction, Fluid friction, Flow friction, Boundary layers, Shores, Ocean waves, Oceanography.

A model was considered of the turbulent bottom boundary layer beneath waves. Closure was effected at the level of the turbulent energy equation, and numerical solutions were obtained by a combination of finite-difference methods and a pseudo-spectral technique. The solutions were used to evaluate the induced streaming motion and the boundary shear stress. An expression was derived for the friction coefficient in terms of the bottom roughness and this was found to agree with values reported in experimental studies. (Sims-ISWS)
W78-01139

UMPQUA RIVER ENTRANCE, OREGON.
Army Engineer District, Vicksburg, MS. Committee on Tidal Hydraulics.
For primary bibliographic entry see Field 8B.
W78-01152

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3B. Water Yield Improvement

WELL REDEVELOPMENT: PART II,
National Water Well Association, Worthington, OH.

T. E. Gass.
Water Well Journal, Vol 31, No 10, p 20-21, October, 1977.

Descriptors: *Water wells, *Maintenance, *Rehabilitation, Chlorination, Surfactants, Acids, Well screens, Aquifers, Iron bacteria, Explosives.

Identifiers: *Well redevelopment, Acidizing, Polyphosphates, Sequestering agents, Jetting, Sonic well cleaning.

Clogging of a well screen and the adjacent formation due to iron bacteria is caused by slimy organic material produced by the bacteria and the iron deposits associated with the organism. These materials may combine with scale minerals such as calcium carbonate. Treatment must, therefore, include a bactericide as well as a strong acid to dissolve scale. Hydroxyacetic acid can be used as such a dual-purpose agent, but many drillers prefer a three-step treatment method involving shock chlorination, acidizing, and a final shock chlorination. Potassium permanganate is a strong oxidizing agent that can also be used to treat iron clogging. For removing silt and clay from a well, sequestering agents such as sodium phosphate can be used to disperse small particles, making them easier to pump out. Surfactants, or wetting agents, can be used to enhance the dispersing efficiency of sequestering agents for the removal of silt and clay. Explosives and sonic well cleaning are two mechanical methods that can be employed in cases where chemical means are inapplicable. No matter what causes declines in well yield, it is always easier to redevelop the well if the problem is diagnosed early and treatment is applied before the well deteriorates to below 50 percent of original specific capacity. (See also W77-12673) (Eberle-NWWA)
W78-00952

REGIONALIZATION FOR FORESTS BASED ON THEIR SIGNIFICANCE FOR WATER MANAGEMENT (RAJONIZACE LESU Z HLEDISKY JEJICH VODOHOSPODARSKEH VYZNAMU),
Vyzkumny Ustav Lesni Hospodarstvi a Myslivosti, Zbraslav-Strnady (Czechoslovakia).

J. Bele.
Lesnictvi, Vol. 23, No. 3, p 151-166, March, 1977. 2 fig, 8 tab, 8 ref. (English summary).

Descriptors: *Hydrology, *Forest watersheds, Foreign countries, Forests, Watershed management, Watersheds(Basins), Water sources, Model studies.

Identifiers: Czechoslovakia, Spruce(Picea).

The hydrologic efficiency of a forest was defined as the amount of available water based on water balance. Such a balance was calculated, i.e., the difference between the horizontal and vertical precipitation and evaporation and transpiration was determined for a model spruce stand. The data obtained were used for large forest areas and, based on the results, Czechoslovakian forests were divided into three groups characterized by amounts of available water of 0-200, 201-400, and 401 mm and more, respectively. The forests with the highest amount of available water were considered as hydrologically important, and they are going to be managed accordingly. The hydrologically important forests occupy 21.8% of the total forest area in Czechoslovakia. (Trubacek-IPC)
W78-01118

3D. Conservation In Domestic and Municipal Use

TETHERING SOLAR POWER IN RHODESIA.
Development Magazine, Vol 11, No 9, p 10-13, January 1977. 2 fig.

Descriptors: Solar heating, Domestic water, *Solar energy, Drying, Equipment, Rhodesia.

It is estimated that between 60 and 70% of all electricity consumed domestically is used for the heating of water and for cooking, and greater utilization of solar energy would do much to lighten the present power station load in Rhodesia. The general requirements of solar water heaters and solar crop dryers are discussed. (So. African Water Info. Center)
W78-00936

3E. Conservation In Industry

CONSIDERATIONS AND POSSIBILITIES OF OPTIMIZING THE WATER CIRCUITS OF THE BRAILA PULP AND PAPER MILL (CONSIDERATII SI POSSIBILITATI PRIVIND OPTIMIZAREA CIRCUITELOR APELOR DE FABRICATIE LA C.C.H.-BRAILA),
G. Neculau, C. Petrescu, V. Popa, and C. Stanciu. Celuloza si Hirtie, Vol 23, No 2, p 63-65, February, 1974. 2 tab, 5 fig, 6 ref.

Descriptors: *Pulp and paper industry, *Water conservation, *Pollution abatement, Water reuse, Recirculated water, Pulp wastes.

Identifiers: Romania.

Water conservation and antipollution measures taken at a Romanian integrated pulp and paper mill are described. The white water recirculation scheme and the effluent treatment installation are also indicated. (Brown-IPC)
W78-00985

WASTE HEAT FOR EVAPORATION OF EF. FLUENTS,
Ekono, Helsinki (Finland).
For primary bibliographic entry see Field 5D.
W78-01105

CLOSING UP KRAFT MILL SYSTEMS - REDUCTION OF EFFLUENTS AND CONTROL OF MATERIAL BALANCES,
Swedish Forest Products Research Lab., Stockholm.
B. Wärnqvist.

Canadian Pulp and Paper Association, Technical Section, Environment Improvement Conference, Montreal, October 6-8, 1976, Preprinted Proceedings (Montreal, P.Q.), p 75-80, 6 fig, 3 tab, 10 ref.

Descriptors: *Pollution abatement, *Pulp and paper industry, Water pollution control, Air pollution, Wastes, Industrial wastes, Effluents, Foreign countries, Sulfur compounds, Pulp wastes, Water reuse, Water pollution sources, Bleaching wastes, Lignins, Computer models, Water conservation, Industrial water.

Identifiers: Closed systems, Sulfur dioxide, Norway, Kraft mills.

The reduction and control of pulp screen room effluents and of sulfur (dioxide) emissions from the recovery furnace by system closure and by internal measures in bleached or unbleached kraft mills are discussed. In-plant solutions for reducing the large fraction of organic compounds in the screen room effluents include extensive brown stock washing, recycling the decker effluent to the screen room, screening at high pulp consistency, and in-line refining with minimum or no screening.

Field 3—WATER SUPPLY AUGMENTATION AND CONSERVATION

Group 3E—Conservation In Industry

A Norwegian integrated mill is described which produces kraft pulp for bag paper and linerboard with in-line refining without screening. A proposal to close this system (continuous digester with high-heat washing zone, in-line refining, washing on drum filters, and high-density storage) suggests that the drum filter effluent be reused counter currently in the high-heat wash and that a radial washer be installed after the refiner to increase chemical recovery. Active control of sulfur and sodium balances is necessary because of environmental restrictions on spent liquor and flue gas discharges. The use of sulfur-free makeup chemicals instead of saltcake, and of oxidized white liquor instead of fresh alkali for flue gas scrubbing, decreases the input sulfur and sodium, respectively. To withdraw excess S, spent bisulfite liquor from the scrubber can be added to the pulp slurry at the end of the chlorination bleaching stage where it facilitates the dissolution of lignin. The end product will be sodium and sulfate ions in the chlorination stage effluent. Computer calculations of the sodium and sulfur balances in a model draft mill using this bisulfite bleed process are discussed. (Schwinternberg-IPC)
W78-01108

DISPOSAL AND RECYCLING OF REJECTS FROM WASTE PAPER AND CLOSED WATER SYSTEMS,
Escher Wyss G.m.b.H. Ravensburg (West Germany).

W. H. Matzke.
British Paper and Board Industry Federation, Technical Section, Waste Utilization Symposium, Manchester, England, January 22-23, 1975 (Preprinted Proceedings), p 163-179. 6 fig.

Descriptors: *Water conservation, *Pulp and paper industry, Water pollution control, Pollution abatement, Flotation, Recycling, Effluents, Sludge, Equipment.
Identifiers: *Board mills, *Deinking mills, Closed systems, Savealls, Waste paper.

The closing of water circuits in a waste paper deinking plant and in a paper and board mill equipped with suction sheet formers are described. The low-volume Escher Wyss Clarflat flotation saveall is also described. The Clarflat cell is run with flocculating aids. Some pressurized air is introduced into the approach flow pipe, but the air consumption is low. The concentration of floated sludge can easily be adjusted in the Clarflat unit. (Sykes-IPC)
W78-01114

TOTAL WATER SYSTEM (AT) COSHOCOTON MILL (OF) STONE CONTAINER CORPORATION,
Stone Container Corp., Coshocton, OH.
W. M. Babington, and L. R. Fisher, Jr.
TAPPI Environmental Conference Papers, Chicago, April 25-27, 1977, (Preprinted Proceedings, TAPPI, Atlanta, Ga.), p 25-31. 4 fig, 5 ref.

Descriptors: *Pulp and paper industry, *Water conservation, Water reuse, Water pollution sources, Ohio, Sludge, Screens, Centrifugation, Aerated lagoons, Waste treatment, Water pollution treatment, Water purification, Industrial water, Sludge treatment, Solid wastes.
Identifiers: *Sulfite pulp mills, *Board mills, Fiber recovery.

Stone Container Corp. operates a 640 ton/day neutral sulfite semichemical corrugating medium mill at Coshocton, Ohio. Low-quality process water used in the chemical recovery system is supplied by a shallow well system. High-quality process water is obtained by processing sludge produced in the city's water treatment plant. Two-thirds of the mill's process waste water (3 million gal/day) is reused. Static screens are used to recover fiber in the raw waste water ahead of the

primary clarifier. Clarifier sludge and thickened municipal lime sludge are centrifuged together. Clarifier overflow is pumped to an aerated lagoon equipped with floating mechanical aerators. Lagoon effluent is discharged directly into the Tuscarawas River. A second-stage aerated lagoon with a subsurface aeration system and a final clarifier are under construction. (Witt-IPC)
W78-01124

WATER QUALITY PROTECTION AT THE (SIMPSON PAPER COMPANY) SHASTA MILL,
Simpson Paper Co., Anderson, CA.
For primary bibliographic entry see Field 5D.
W78-01130

LEATHER TANNERY WASTE MANAGEMENT THROUGH PROCESS CHANGE, REUSE AND PRETREATMENT,
Pfister and Vogel Tanning Co., Milwaukee, WI.
For primary bibliographic entry see Field 5D.
W78-01156

NAVAL STORES WASTEWATER PURIFICATION AND REUSE BY ACTIVATED CARBON TREATMENT,
Hercules Inc., Hattiesburg, MS.
For primary bibliographic entry see Field 5D.
W78-01160

REVERSE OSMOSIS FIELD TEST: TREATMENT OF WATTS NICKEL RINSE WATERS,
Abcor, Inc., Wilmington, MA.
For primary bibliographic entry see Field 5D.
W78-01161

STATE OF THE ART: WASTEWATER MANAGEMENT IN THE BEVERAGE INDUSTRY,
Industrial Environmental Research Lab.-Cincinnati, Corvallis, OR. Food and Wood Products Branch.
For primary bibliographic entry see Field 5D.
W78-01168

3F. Conservation In Agriculture

IRRIGATION OF SUGAR CANE,
South African Sugar Association Experiment Station, Mount Edgecombe.
G. D. Thompson.
South African Sugar Journal, Vol. 61, No. 3, p 126-131, March 1977. 3 fig, 5 tab.

Descriptors: *Irrigation practices, *Sugar cane, Rainfall, Soil moisture, Crop production.
Identifiers: South Africa.

The purpose of this review is to collate the pertinent available information, to assess the adequacy of the present state of knowledge, and to dictate the aspects of irrigation research that appear to most warrant further investigation. Within the South African sugar belt it is possible to discriminate between areas where irrigation is used to increase yields obtainable under rainfall conditions, and areas where irrigation is necessary to guarantee continuous sugarcane production. It has become traditional to refer to the former as areas requiring 'supplementary' irrigation, and to the latter as requiring 'total' irrigation. The decision to install a supplementary irrigation scheme in the rainfall areas is unfortunately seldom an easy one to make. Capital and running costs in relation to the value of the extra cane produced have always been such that profitability has been marginal, and most of the schemes which have remained in operation have on miller-cum-planter estates where milling profits can be used to make irrigation more worthwhile, and on fields as close as possible to the mill itself so that transport costs for

the increased crop can be kept to a minimum. (So. African Water Info Center)
W78-00928

USES OF PHRAGMITES AUSTRALIS (IN AFRIKAANS),
Agricultural Research Inst., Middleburg (South Africa).
For primary bibliographic entry see Field 4A.
W78-00933

TETHERING SOLAR POWER IN RHODESIA.
For primary bibliographic entry see Field 3D.
W78-00936

IMPLEMENTATION OF FIELD LAYOUT FOR MECHANIZATION AND SURFACE WATER CONTROL,
South African Sugar Association Experiment Station, Mount Edgecombe.
For primary bibliographic entry see Field 4A.
W78-00942

THE INFLUENCE OF FERTILIZER-APPLIED CHLORINE, CHLORINE CONTENT OF IRRIGATION WATER AND LEACHING OF CHLORINE ON THE UPTAKE OF CHLORINE BY TOBACCO (IN AFRIKAANS),
Tobacco Research Inst., Rustenburg (South Africa).
H. G. Snyman, J. G. K. Coetzee, F. J. Shawe, and H. J. Boshoff.
Agrochemophysica, Vol 8, p 23-30, 1976. 6 fig, 3 tab, 10 ref. (English summary).

Descriptors: *Tobacco, *Chlorine, Leaching, Fertilizers, Irrigation, *Absorption, Drainage, Soil types.
Identifiers: Nicotiana.

In a field trial with tobacco the effect of leaching of applied Cl fertilizer from the soil under natural rainfall conditions on the uptake of chlorine by the plant was investigated. The leaching of chloride from the soil is very closely linked with natural rainfall. Soil and leaf analyses clearly showed that with a rainfall of 900 mm during the 1966/67 growing season (November to March), an application of 212 kg of Cl per ha was completely leached out from the 0-900 mm earth layer, even when the removal of Cl by the plant was taken into account. This was reflected in the leaf analyses during the same season where a very low chloride content was registered. Even at the highest applications of chloride of 212 kg/ha, only 1.50, 0.66 and 0.56% chloride were registered for the lower, middle and top leaves respectively. Chlorine in the irrigation water is the most important contributory factor to high chlorine content in tobacco. (So. African Water Info. Center)
W78-00943

TESTS ON SPRINKLERS (IN AFRIKAANS),
Pretoria Univ. (South Africa). Dept. of Agricultural Engineering.
F. K. Geertsema.
Agricultural Engineering in South Africa, Vol 10, No 1, p 53-57, 1976. 1 fig, 1 tab, 2 ref. (English summary).

Descriptors: *Sprinklers, *Irrigation practice, *Sprinkler irrigation, Equipment, Sprays.

A brief description is given of the tests conducted on sprinklers at the Division of Agricultural Engineering, Silverton, Pretoria. The method of determining the Christiansen Coefficient of Uniformity (CU-value) is discussed in more detail. The relationship between the CU-value and the following aspects is stated: Percentage wet and dry areas, Patterns of setting: rectangular and triangular, Single or double nozzle. In this connection it has been determined whether a single or

WATER SUPPLY AUGMENTATION AND CONSERVATION—Field 3

Conservation In Agriculture—Group 3F

double nozzle-sprinkle gives the best results on a rectangular or square setting. Pressure, Stream straightener. The Christiansen Coefficient however has its limitations as norm for the judgement of any sprinkler's suitability for a specific task. (So African Water Info. Center)

W78-00944

THE ROLE OF WATER NUTRITION AND YIELD LEVEL IN THE GRAIN-STALK RATIO OF MAIZE (IN AFRIKAANS).
Pretoria Univ. (South Africa). Dept. of Plant Production.

P. C. Nel, and J. F. Verwey.

Agroplantae, Vol. 8, No. 4, p 65-68, 1976. 1 fig, 3 tab, 12 ref. (English summary).

Descriptors: *Corn(Field), Crop response, Crop production, *Nutrient requirements, Water demand, Soil-water-plant relationships.

Identifiers: Grain-stalk ratio.

The effect of fertilization with N, P, K and farm-yard manure and of the level of irrigation on the grain:stalk ratio of the maize cultivar R200 was determined. An established long term field experiment, in which the various effects had stabilized over the years, was used for this investigation. At a low water level only K made a significant contribution to grain:stalk ratio. Where the availability of water was continually at a high level, the contribution of nitrogen, phosphorous, potassium and farm-yard manure to the grain:stalk ratio was significant. From the highly significant correlation coefficient ($r=0.857$) and regression coefficient it is deductible that the grain:stalk ratio increases linearly by 0,0575 with an increase of 1 000 kg/ha in grain yield. (So. African Water Info. Center)

W78-00946

THE INFLUENCE OF CERTAIN CULTIVATION PRACTICES ON THE GROWTH AND PRODUCTION OF ZEA MAYS IN MARGINAL AREAS (IN AFRIKAANS).
Orange Free State Univ., Bloemfontein (South Africa).

L. P. De Bruyn, and J. J. Human.

Agroplantae, Vol. 8, No. 4, p 69-75, 1976. 6 tab, 10 ref. (English summary).

Descriptors: *Corn(Field), *Crop response, Soil moisture, Cultivation.

Different cultivation practices by which soil moisture may be stored or utilized more efficiently by the maize plant, were compared in order to obtain higher yields in marginal areas. This was done in three different experiments on soil of the Kinross series of the Shortlands farm at the Glen Agricultural Research Institute. The first of these experiments compared the growth and yields of maize continuously cropped with those obtained where maize was planted in alternate seasons on previously summer fallow soil. Plant population at two levels (1,79 and 2,38 plants/m²) was used. These treatments were used in a 2 x 2 factorial arrangement in a randomized block design with six replications. Stored soil moisture significantly enhanced grain, stover and total dry material yields as well as the grain/stover ratio. Stored moisture was therefore used for vegetative growth, and to a greater extent for grain production. Yields obtained during four seasons averaged an increase of 477,8 kg/ha where maize was planted on previously fallow soil. Continuous cropping, however, averaged 1 773,4 kg/ha and the increase in yield after fallow consequently did not compensate for the loss in yield due to fallow. The additional moisture due to summer fallow was not sufficient to justify a higher plant density. Thus 1,79 plants/m² significantly outyielded 2,38 plants/m² by 249,3 kg/ha. (So. African Water Info. Center)

W78-00947

THE PERIODS SENSITIVE TO INTERNAL PLANT MOISTURE STRESS DURING GROWTH AND DEVELOPMENT OF ZEA MAYS (IN AFRIKAANS).
Orange Free State Univ., Bloemfontein (South Africa).

L. P. De Bruyn, and J. J. Human.

Agroplantae, Vol. 8, No. 4, p 77-81, 1976. 1 tab, 1 fig, 15 ref. (English summary).

Descriptors: *Moisture stress, Soil-water-plant relationships, Water demand, Crop response, Soil moisture, Growth stages, *Corn(Field).

The first 70 days had little effect on grain yields. In marginal areas the period of sensitivity to moisture deficits during flowering commences 70 days after planting. During tasseling and silking 77-80 days after planting, sensitivity decreases somewhat although the plant remains significantly sensitive. Dry weather enhances pollination and flowering and the sensitivity therefore decreases 81-83 days after flowering. Peak flowering is the most sensitive period and its duration is 84-92 days with the peak sensitivity being reached 90 days after planting. Fertilization of the greater number of silks takes place 93-100 days after planting when sensitivity to moisture stress drops sharply. Subsequently, the plant remains insensitive to internal moisture deficits except during the seed fill stage which is represented by a slight rise in sensitivity 126-130 days after planting. The grain to stover ratio indicates that moisture was used for grain production at the cost of vegetative growth 75-84 days after planting. (So. African Water Info. Center)

W78-00948

LEAST COST IRRIGATION SYSTEM SPECIFICATIONS FOR VARIOUS CONDITIONS.
Idaho Univ., Moscow. Dept. of Agricultural Engineering.

R. J. Busch.
Paper No. 76-2038, Presented at the Annual Meeting of the American Society of Agricultural Engineers, June 27-30, 1976, Lincoln, Nebraska. 13 p, 3 fig, 7 tab, 4 ref. OWRT B-028-IDA(5) and B-033-IDA(6).

Descriptors: Model studies, Simulation analysis, Optimization, *Irrigation efficiency, Costs, *Linear programming.

A methodology employing a dynamic-linear programming model was used to develop optimum rehabilitation plans for an irrigation district. The plans developed indicate the total irrigation system cost and configuration for various levels of efficiency and water cost. (Skogerboe-Colorado State)

W78-00973

PROTECTION OF A UNIQUE ECOLOGICAL AREA THROUGH IMPROVED WATER AND FERTILITY MANAGEMENT.
Nebraska Univ., Lincoln. Dept. of Agricultural Engineering.

For primary bibliographic entry see Field 2G.
W78-01001

COST COMPARISON OF DRIP AND FLOOD IRRIGATION SYSTEMS,
Texas A and I Univ., Weslaco. Citrus and Vegetable Training Center.

P. J. Rathwell, and R. F. Leyden.

Journal of the Rio Grande Valley Horticultural Society, Vol. 30, p 79-86, 1976, 1 fig, 3 tab, 4 ref.

Descriptors: *Irrigation systems, *Surface irrigation, *Flood irrigation, *Citrus fruits, *Cost comparisons, Irrigation, Irrigation efficiency, Orchards, Crop production, Irrigation design, Costs, Texas, Semiarid climates, Water requirements.

Identifiers: *Drip irrigation.

Drip irrigation and conventional surface flood irrigation for citrus orchards are compared with respect to installation and operating costs. Observations were made at an experimental citrus center in the Lower Rio Grande Valley of Texas. The results are presented. Drip irrigation provides a substantial savings of water in newly planted orchards, but as trees grow, water requirements are about the same under either drip or flood irrigation. The investment costs are comparable for both systems. The savings associated with a drip system are achieved during the first years of an orchard's existence. The labor involved in maintaining and cleaning the drip system is likely to be comparable to the irrigation labor required in a leveled orchard. Electrical costs may run high if the drip system is not engineered to deliver the required amount of water at a minimum electrical usage. (Jamaal-Arizona)

W78-01048

AIR REGIME OF NONIRRIGATED AND IRRIGATED CISCAUCASIAN CHERNOZEMS.
Moscow State Univ. (USSR). Dept. of Soil Science.

N. G. Zborishchuk.
Soviet Soil Science, Vol. 8, No. 1, p 85-91, January-February, 1976, 3 fig, 3 tab, 8 ref.

Descriptors: *Irrigation effects, *Soil properties, *Soil compaction, *Aeration, Irrigation, Physical properties, Porosity, Carbon dioxide, Soil physical properties, Soil density, Soil physics, Oxygen. Identifiers: U.S.S.R., Soil air.

Soil air is an important and very mobile part of the soil. The partial pressure of gases in soil air affects plant development conditions and the solubility of mineral compounds. Investigations were conducted to determine the air regimes of irrigated and nonirrigated Ciscaucasian Chernozems in the U.S.S.R. and the results are presented. It is demonstrated that irrigation changes some physical soil properties. It reduces the air reserves and aeration porosity. This promotes the accumulation of carbon dioxide in soil air, the content of which is twice as high in horizons of irrigated soils than in nonirrigated soils. Irrigation disturbs gas exchange in soils and promotes carbon dioxide accumulation. The longer the duration of the irrigation, the more pronounced this process becomes. (Jamaal-Arizona)

W78-01049

MECHANISMS OF SURVIVAL OF ZOOSPORES OF PHYTOPHTHORA PARASITICA IN IRRIGATION WATER,
California Univ., Berkeley. Dept. of Plant Pathology.

S. V. Thomson, and R. M. Allen.

Phytopathology, Vol 66, No 10, p 1198-1202, October, 1976, 2 fig, 2 tab, 26 ref.

Descriptors: *Irrigation water, *Citrus fruits, *Arizona, *Rots, *Water reuse, Irrigation, Texas, Plant diseases, Fungi, Microorganisms, Plant pathology, Irrigation ditches, Orchards, Diseases, Fruit crops, Root systems. Identifiers: *Zoospores, *Phytophtora parasitica.

Foot rot in citrus which is caused by several species of Phytophtora is discussed. The disease is a limiting factor for the production of citrus in Arizona because some 20% of the acres planted in citrus are affected. A practice that contributes to the spread and severity of the disease is the reuse of irrigation water. Zoospores of Phytophtora have been recovered from recycled irrigation water in Arizona. Information is presented on the survival of propagules of Phytophtora parasitica in irrigation water with special emphasis on zoospores. Samples were taken from irrigation drainage near Phoenix, Arizona, and were tested in a laboratory. P. parasites survived in irrigation water for several weeks. Thus, water recycled from citrus should not be used on citrus orchards.

Field 3—WATER SUPPLY AUGMENTATION AND CONSERVATION

Group 3F—Conservation In Agriculture

and new orchards should not be planted where there is likelihood of exposure to contaminated irrigation water. (Jamaal-Arizona)
W78-01055

STATE-OF-THE-ART: SWINE WASTE PRODUCTION AND PRETREATMENT PROCESSES,
North Carolina State Univ. at Raleigh. Dept. of Biological and Agricultural Engineering.
For primary bibliographic entry see Field 5D.
W78-01169

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

USES OF PHRAGMITES AUSTRALIS (IN AFRIKAANS),
Agricultural Research Inst., Middleburg (South Africa).

L. Viljoen.
Proceedings of the Grassland Society of Southern Africa, Vol. 11, p 19-22, 1976. 1 fig, 4 tab, 10 ref. (English summary).

Descriptors: *Aquatic plants, Erosion control, Marshes, River flow, Sediment control, *Bank stabilization, Rooted aquatic plants, Soil conservation, Reeds.

Identifiers: Phragmites australis.

Phragmites australis (*communis*) is one of the most widely distributed of the Angiosperme. This can be attributed to its adaptability and to the fact that it can propagate both vegetatively and by means of seed. It is because of these propagation properties that it is so useful for soil conservation and for the stabilization of sediment, gully banks and channels. Of particular value is its ability to withstand inundation, washing out and sediment deposition. It is normally grown in relatively moist soils where in addition to the role it plays in soil conservation, it produces large quantities of palatable grazing for cattle. (So. African Water Info. Center)
W78-00933

IMPLEMENTATION OF FIELD LAYOUT FOR MECHANIZATION AND SURFACE WATER CONTROL,
South African Sugar Association Experiment Station, Mount Edgecombe.
O. P. Landrey, J. P. Fourie, and N. A. Johnston.
South African Sugar Journal, Vol 60, No 4, p 165-175, April, 1976. 11 fig, 2 tab.

Descriptors: Crop production, *Cultivated lands, *Sugarcane, Slopes, Soil conservation, Soil erosion, Surface runoff, Drainage.

Escalating costs and the uncertain availability of labor have provided motivation for greater mechanization of field operations. It is difficult for machines to cope with irregular terrain, varying row widths and the presence of short lines, and hence it has become necessary to revise methods for laying out sugarcane fields. The principals involved, the necessary design criteria and the techniques for their implementation have been established in an attempt to solve the problem of mechanizing can production on the steep and often rugged terrain found in the South African sugar industry. (So. African Water Info. Center)
W78-00942

RESERVOIR CAPACITY FOR PERIODIC-STOCHASTIC INPUT AND PERIODIC OUTPUT,
Colorado State Univ., Fort Collins.

K. N. Mutreja.
Hydrology Papers No. 86, September 1976. 42 p, 34 fig, 20 tab, 36 ref.

Descriptors: *Reservoir storage, *Model studies, *Inflow, Water storage, Reservoir operation, Reservoir releases, Hydrology, Reservoirs, Stochastic processes, Markov processes.

Identifiers: *Periodic-stochastic input, Periodic output, Flow regulation, High-order autoregressive model, Reservoir capacity, Difference storage, Stochastic storage.

A methodology was developed for designing capacities of large reservoirs with sufficiently high levels of development by using the concept of maximum deficit rather than the range and short-interval flow records, particularly daily flows. Daily river flow, composed of periodic and stochastic components, are inputs into reservoirs. The output was assumed to be a deterministic process, either constant or periodic. Difference storage is due to periodic components of both input and output. The advantage of the use of difference storage is that it is approximately constant for large sample sizes. Therefore, difference storage can be estimated for different sample sizes by generating a relatively short series of daily flows. The parameters of asymptotic distribution of statistics of partial sums can be obtained by equating the higher-order autoregressive models to an equivalent first-order autoregressive model with its rho sub 1 equal to the sum of all the autoregressive coefficients of the higher-order model. This is valid for all storage problems of practical interest. (Lee-ISWS)
W78-01012

4B. Groundwater Management

RAINING THE WATER PROJECTS OUT OF THE PORK BARREL,
J. D. Kirschten.

National Journal, Vol. 9, No. 15, p 540-548, April 9, 1977.

Descriptors: *Water policy, *Federal-State water rights conflicts, *Federal project policy, *Water resources development, *Colorado River basin, *Arizona, Federal government, Project purposes, Project feasibility, Colorado River, Water resources, Arid lands, Southwest, Water conservation, Environmental effects, Planning, Hoover Dam.

Identifiers: *Central Arizona project.

The attempt of the Carter Administration to shape a comprehensive national water policy is discussed. Problems resulting from past water policies are coming to a head in many areas of the country, perhaps most dramatically in the water-short Colorado River Basin. The particular problems of the Colorado River Basin are discussed from a historical perspective. (Ullyer-Arizona)
W78-01045

USER REQUIREMENTS AND USER ACCEPTANCE OF CURRENT AND NEXT-GENERATION SATELLITE MISSION AND SENSOR COMPLEMENT, ORIENTED TOWARD THE MONITORING OF WATER RESOURCES,
Ecosystems International, Inc., Gambrills, MD.
For primary bibliographic entry see Field 7B.
W78-01155

Descriptors: *Groundwater, *Water policy, *Water law, *Water management(Applied), Water resources development, Administrative agencies, Governments, Water pollution control, Conjunctive use, Surface-groundwater relationships.

Identifiers: *National Water Commission, US Geological Survey.

Recommendations made by the National Water Commission offer a sound basis for management of the nation's ground water resources, including protection of ground water quality. However, it appears that little has been done to implement those recommendations since the Commission's report in 1973. NWC considered a wide variety of subjects relating to the water resources of the nation, including considerable emphasis on management of ground water resources and protection of ground water quality. Of particular interest were reports on state water laws, ground water law and administration, and on ground water management. The first steps toward full implementation of the Commission's recommendations should include (1) encouraging each state to enact the necessary body of law to achieve comprehensive, integrated management and control of its surface and ground water resources, and (2) reviewing and revising as necessary the several federal water resource programs to accord with the concept of comprehensive water resource management. (Eberle-NWWA)
W78-00966

GROUND-WATER RESOURCES OF THE LOWER SANTIAM RIVER BASIN, MIDDLE WILAMETTE VALLEY, OREGON

Geological Survey, Sacramento, CA. Water Resources Div.; and Geological Survey, Portland, OR. Water Resources Div.

D. C. Helm and A. R. Leonard.
Oregon Water Resources Department Ground-Water Report No 25, 1977. 75 p, 15 fig, 1 plate, 13 tab, 46 ref.

Descriptors: *Groundwater resources, *Aquifer characteristics, *Hydrogeology, *Water quality, *Oregon, Hydrologic data, Water wells, Well data, Water yield, Irrigation, Drawdown, Groundwater recharge, Water level fluctuations, Alluvium aquifers, Groundwater availability, Projections, Maps.

Identifiers: *Lower Santiam River basin(Oreg), *Willamette Valley.

The lower Santiam River basin includes a 600-sq mi area in the middle Willamette River valley and adjacent foothills of the Cascade Range. Most ground-water development is in the 200-sq mi valley plains where alluvial aquifers contain about 2 million acre-ft of water. Those aquifers are recharged by winter precipitation, and the seasonal change in storage is about 190,000 acre-ft. In 1967, about 35,000 acre-ft of ground water was pumped, 85 percent for irrigation. The alluvial aquifers can sustain large additional withdrawals, at the expense of local evapotranspiration and seepage to streams. Volcanic and marine sedimentary rocks in the uplands serve as minor aquifers that yield adequate ground water for stock and domestic supplies. In one small area, the Columbia River Basalt Group yields water for irrigation, but water levels in the area are declining. Water in the lower Santiam basin generally is chemically suitable for drinking, irrigation, and most other uses. Saline water occurs locally in the consolidated rocks. (Woodard-USGS)
W78-01084

SUMMARY OF GROUND-WATER CONDITIONS IN THE JAFFNA PENINSULA, REPUBLIC OF SRI LANKA, WITH A PLAN FOR INVESTIGATING FEASIBILITY OF GROUND-WATER DEVELOPMENT,
Geological Survey, Trenton, NJ. Water Resources Div.
H. Meisler.

WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

Identification Of Pollutants—Group 5A

Open-file report 77-558, 1977. 47 p, 2 fig, 3 tab, 10 ref.

Descriptors: *Water resources development, *Groundwater resources, *Aquifer characteristics, *Saline water-freshwater interfaces, Foreign projects, Water wells, Pumping, Irrigation, Drawdown, Groundwater recharge, Springs, Monsoons, Wet seasons, Limestones, Karst, Lagoons, Hydrogeology, Water balance, Saline water intrusion, Evaluation, Groundwater availability.

Identifiers: *Ceylon, Sri Lanka, Jaffna Peninsula.

Ground water in the Jaffna Peninsula of Sri Lanka, Ceylon, occurs within solution openings of the Jaffna Limestone of Miocene age. The fresh-water forms a complex of lenses up to 25 meters thick overlying saline water derived from the sea. Salt-water intrusion and upconing of the salt water has occurred at several locations primarily along the coast. Recharge to the aquifer occurs during October-December. Discharge is primarily to wells and to springs along the north coast. Spring discharge is small compared to withdrawal from wells. Pumping from wells in an intensively studied 142-square-kilometer area of the Peninsula was 55.5 million cubic meters in 1976, whereas discharge to visible springs was an estimated 9.3 million cubic meters. Pumping during January-September removes water from storage causing heads to decline and the salt water-freshwater interface to rise. The storage is replenished as heads increase and the interface is depressed during the following October-December. Consequently, most of the recharge goes into storage rather than discharging to the sea. (Woodard-USGS) W78-01093

4C. Effects On Water Of Man's Non-Water Activities

POLICY IMPLICATIONS OF URBAN LAND PRACTICES FOR GROUNDWATER QUALITY, American Inst. of Planners, Washington, DC.

H. F. Wise.

Water and Sewage Works, Vol 124, No 10, p 84-85, October, 1977.

Descriptors: *Groundwater, *Urbanization, City planning, Legislation, Land use, Community development.

Identifiers: *Non-point sources of pollution.

Planning agencies in the United States are progressively turning away from end-state planning and are looking into planning for gradual development by stages. Cost of urban sprawl and strength of various pieces of federal legislation on environment and resource control have helped bring this about. In addition, HUD has signed agreements reconciling its planning assistance programs and land use planning requirements to several important environmental agencies and programs. Section 208 of the Federal Water Pollution Control Act deserves special mention in this regard. Around the country, the implications of non-point source contributions of pollutants to the quality of the streams and lakes of the nation are just beginning to be understood. Management of non-point sources will be critical in maintaining ground water quality in the future. On the whole, however, signs are positive for increasing attention to environmental issues in land use planning. (Eberle-NWWA) W78-00958

THE IMPACT OF SECOND-HOME DEVELOPMENT ON WATER AVAILABILITY IN NORTH CENTRAL ARIZONA, Arizona State Univ., Tempe. Bureau of Business and Economic Research.

M. E. Bond, and R. H. Dunikoski.

Eisenhower Consortium Institutional Series Report No 1, April, 1977. 88 p, 1 fig, 20 tab, 35 ref, 3 append.

Descriptors: *Groundwater availability, *Water demand, *Arizona, *Waste water disposal, *Recreation, Forest management, Data collections, Water resources, Water availability, Overdraft, Waste water(Pollution), Water pollution, Wells, Surface water availability, Water supply, Water policy, Forecasting, Future planning(Projected), Arid lands, Water consumption.

Identifiers: Housing, Second-home development.

Objectives, designed for their relevance to the State of Arizona and the U.S. Forest Service, include a second home inventory and future projections, estimates of construction needs; data on current water requirements and waste water volume, projections of future water demands and wastes for various types of second homes; data on water availability; and a comparison of demand estimates with water availability as a basis for evaluating the impact of alternative types of second-home developments on water availability and quality in those areas of Arizona where such development is concentrated. The report defines a 'second-home,' describes trends in their development, and identifies development issues. The literature is reviewed of development trends and water consumption; the methodology employed in estimating the inventory is discussed; 1974 water consumption data estimating waste water is presented; future water demands for 1980 and 1985 are estimated; and the effect of the water supply issue in Arizona on future development is discussed. (Ullery-Arizona) W78-01052

4D. Watershed Protection

FRICITION FACTORS FOR VEGETATED WATERWAYS OF SMALL SLOPE, Agricultural Research Service, Stillwater, OK. Water Conservation Structures Lab.

For primary bibliographic entry see Field 2E.

W78-01031

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

SWAN MORTALITY DUE TO CERTAIN HEAVY METALS IN THE MISSION LAKE AREA, IDAHO, Idaho State Dept. of Health and Welfare, Boise.

Community Study on Pesticides.

For primary bibliographic entry see Field 5C.

W78-00903

PATELLA VULGATA: A BIOLOGICAL MONITOR OF COASTAL METAL POLLUTION - A PRELIMINARY STUDY.

Hebrew Univ., Rehovot (Israel). Faculty of Agriculture.

J. Navrot, A. J. Amiel, and J. Kronfeld.

Environmental Pollution, Vol. 7, p. 303-308, 1974. 2 fig, 1 tab, 11 ref.

Descriptors: *Trace elements, *Monitoring, *Heavy metals, *Silver, *Mercury, *Chromium, *Nickel, *Copper, *Zinc, *Mollusks, *Waste water(Pollution), *Strontium, *Carbonates, Water analysis, Water chemistry, Path of pollutants, Water pollution sources, Water pollution effects, *Bioindicators.

Identifiers: Tissue analysis, Bioaccumulation, *Limpet, Patella.

The measurement of trace element concentrations in the living tissue of the limpet *Patella vulgata* was proposed as a rapid and inexpensive technique for monitoring pollution of coastal water. Preliminary investigation of the heavy metal content, including Ag, Hg, Cr, Ni, Cu, and Zn, of both the skeletal and living parts of this common coastal mollusc was carried out on samples collected along the shore from Tel-Aviv at the Reading sewage pipe, to Dor. While the trace metal content of the carbonate skeletal material remained constant over this interval, significant variations were noted in the soft parts. The decrease in metal uptake appeared to be a function of increasing distance from the main source of contamination. (Katz) W78-00906

MEASUREMENT OF PERIODIC OPEN AND SHUT SHELL MOVEMENT OF BIVALVES BY THE STRAIN-GAUGE METHOD, Thoku Region Fisheries Research Lab., Shiogama (Japan).

For primary bibliographic entry see Field 7B. W78-00911

SPECTROPHOTOMETRIC DETERMINATION OF MINERAL OILS IN WATER, (IN RUSSIAN), Institut Gigieny Truda i Profzabolevanii, Sverdlovsk (USSR).

G. A. Sereda, and V. A. Artemova. Gig Sanit 9, 69-71. 1976.

Descriptors: *Mineral oils, *Spectrophotometry, Sewage.

High sensitivity, accuracy and reproducibility were established for the method. Sensitivity for transformer oil was 0.4 microg/ml, for turbine oil 1.2 microg/ml and for compressor oil 0.8 microg/ml. Since organic admixtures and inorganic salts used in water purification did not affect the analysis, the method can be considered to be sufficiently selective and can be used for quantitative analysis of mineral oils in sewage. Copyright 1977, Biological Abstracts, Inc. W78-00912

A PLEXIGLASS SUBSAMPLING BOX FOR LARGE BENTHOS SAMPLES, QLM Labs., Inc., Oswego, NY.

For primary bibliographic entry see Field 7B. W78-00913

A SALTWATER FLOW-THROUGH BIOASSAY METHOD WITH CONTROLLED TEMPERATURE AND SALINITY, Environmental Research Lab., Gulf Breeze, FL.

L. H. Bahner, C. D. Craft, and D. R. Nimmo. The Progressive Fish-Culturist, Vol 37, No 3, p 126-129, 1975. 1 fig, 5 ref.

Descriptors: *Design, *Research equipment, *Research and development, *Bioassay, *Salinity, *Temperature, Methodology, Shrimp, Crustaceans, Costs, Laboratory tests, Saltwater. Identifiers: *Flow-through bioassay, Pink shrimp, Penaeus sp.

A saltwater flow-through bioassay system was developed with mechanisms for temperature and salinity controls so that experimental conditions could be accurately repeated. The system was used in bioassays with the pink shrimp, *Penaeus duorarum*, and the grass shrimp, *P. pugio*. Design, cost, and operational instructions were given. (Katz) W78-00917

RESIDUE ANALYSES ON 2-AMINO-4-PHENYLTHIAZOLE, A PISCINE ANESTHETIC, IN FISHES - III METABOLISM IN RAINBOW TROUT AND CARP, Meiji Seiki Kaisha Ltd., Yokohama (Japan). Research Labs.

Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5A—Identification Of Pollutants

A. Suzuki, M. Shimura, T. Kikuchi, and Y. Sekizawa.

Bulletin of the Japanese Society of Scientific Fisheries, Vol. 43, No. 7, p 837-847, 1977. 9 fig, 2 tab, 6 ref.

Descriptors: *Rainbow trout, Fish physiology, *Metabolism, *Chemical analysis, *Carp, *Chromatography, *Spectroscopy, *Radiochemical analysis, *Tritium, *Traces, Analytical techniques, Organic compounds, Qualitative analysis, Radioisotopes, Water analysis, Aquaculture, *Pollutant identification.

Identifiers: Biotransformation, *Anesthetics, Tissue analysis.

The major biotransformation product of 2-amino-4-phenylthiazole in rainbow trout (*Salmo gairdneri* irideus) was isolated from water following exposure to the anesthetic. The isolated crystalline metabolite was shown by means of ultraviolet, infrared and optical rotatory dispersion spectroscopy and gas chromatography to be identical to 2-amino-4-phenylthiazole-2-N-beta-mono-D-glucopyranosiduron acid, the major biotransformation product previously found in medaka (killifish, *Oryzias latipes*). The major biotransformation product in carp (*Cyprinus carpio*) was also identified as 2-amino-4-phenylthiazole-2-N-beta-mono-D-glucopyranosiduron acid. Conversion of 2-amino-4-phenylthiazole to the N-glucuronyl conjugate was 8 and 12%, respectively, in rainbow trout and carp. (Katz)

W78-00923

A SIMPLE PORTABLE VACUUM PUMP, University of the Witwatersrand, Johannesburg (South Africa). Dept. of Botany.

R. D. King.
Journal of the Limnological Society of Southern Africa, Vol. 2, No. 2, p 63, 1976. 1 fig.

Descriptors: Vacuum pumps, Equipment, Description, *Pumps, *Sampling, On-site tests.

A vacuum pump is described which was used for long periods at a remote field station where very few facilities are available (Nuffield Lake Kariba Research Station, Rhodesia). The pump had to be simple, cheap to build and operate, and maintained by unskilled personnel. A further requirement was that the pump be operated in a small boat so that samples could be filtered immediately after collection (e.g., algae filtered on to glass fiber discs and placed into methanol for photosynthetic pigment extraction within 10 minutes of being collected.) This was necessary because of the high ambient air temperatures in the Zambezi Valley and the lack of accessible refrigeration equipment for sample storage. (So. Africa Water Info. Center)

W78-00931

ALGAL BIOASSAYS AND NITROGEN FIXATION, National Inst. for Water Research, Pretoria (South Africa).

R. D. Walmsley, and D. F. Toerien.
South African Journal of Science, Vol 71, p 313-314, October 1975. 2 fig, 10 ref.

Descriptors: *Algae, *Nitrogen fixation, *Eutrophication, Phosphorus, Nutrients, *Bioassay.

Identifiers: *Selenastrum*, *Anabaena*.

The algal bioassay procedure used to establish the eutrophication level of Rietvlei dam is discussed. *Selenastrum capricornutum* and *Anabaena flos-aquae* were used. *S. capricornutum* was the more convenient organism for the freshwater bioassays. (So. African Water Info. Center)

W78-00940

THE USE OF THE ISOTOPE 32P IN THE STUDY OF SOME ECOLOGICAL ASPECTS OF

A LABORATORY STREAM ECOSYSTEM (IN AFRIKAANS),

Randse Afrikaanse Univ., Johannesburg (South Africa). Navorsingsgroep vir Varswaterbiologie. H. J. Schoonbee, J. H. Swanepoel, and J. J. M. Van Graan.

Tydskrif vir Natuurwetenskappe, Vol. 15, No. 2, p 48-66, 1975. 7 fig, 9 tab, 24 ref. (English summary).

Descriptors: *Eutrophication, Sediments, Invertebrates, Fish, *Benthic flora, *Phosphorus radioisotopes, Laboratory tests, Ecosystems.

Identifiers: South Africa, Witwatersrand, *Potamogeton pectinatus*, *Apocheilichthys johnstonii*.

A laboratory stream consisting of two stream sections interrupted by two pools was filled with a mixture of tap water and organically enriched water from rivers nearby. Bottom sediment material, *Potamogeton pectinatus*, macroinvertebrate organisms, as well as the mosquito fish, *Apocheilichthys johnstonii* were collected from rivers around Johannesburg and introduced into the laboratory stream. After initial acclimation, the distribution of the isotope 32P through this laboratory stream was followed. Absorption of this isotope by benthic algae, *Potamogeton pectinatus*, several macro-invertebrate organisms as well as *Apocheilichthys johnstonii* was recorded. (So. African Water Info. Center)

W78-00945

SPECTROFLUOROMETRIC DIFFERENTIATION OF THE RED TIDE ALGA, GONYAULAX TAMARENSIS FROM OTHER ALGAE COMMON TO NEW ENGLAND WATERS,

Massachusetts Inst. of Tech., Cambridge.

For primary bibliographic entry see Field 5C.

W78-00950

WATER QUALITY STUDIES OF SIXTEEN MINNESOTA RIVERS TRIBUTARY TO LAKE SUPERIOR,

Reserve Mining Co., Silver Bay, MN.

D. M. Wagner, R. S. Lemire, and D. W. Anderson.
Journal of Great Lakes Research, Vol. 2, No. 1, p 111-123, July 1976. 1 fig, 6 tab, 12 ref.

Descriptors: *Water quality, *Rivers, *Lake Superior, *Surveys, *Minnesota, Pollutants, Dissolved solids, Conductivity, Hydrogen ion concentration, Coliforms, Nutrients, Heavy metals, Silica, Chlorides, Calcium, Magnesium, Sodium, Potassium, Sulfates, Water pollution, Lakes, Water chemistry.

Water quality characteristics of 16 Minnesota rivers tributary to Lake Superior were studied during the period June 1971 to June 1972. Chemical, physical, and biological measurements included 8 major and 13 minor parameters, pH, conductivity, and coliform bacteria. The results of the one-year survey indicated which parameters exhibit seasonal differences, that there is an apparent cultural influence on some of the rivers studied, and that heavy rainfalls of short duration cause immediate and pronounced water quality changes.

The spring thaw was characterized by an initial increase in the concentrations of dissolved constituents in the rivers, followed by a substantial decrease as the melt runoff period progressed. Quantities of soluble chemical constituents discharged to Lake Superior during the study period from all rivers sampled were calculated using published and computed annual discharge data. The total quantity of dissolved solids discharged to Lake Superior by the 16 rivers was approximately 339,600 metric tons per year. (Sims-
ISWS)

W78-01036

DETROIT RIVER FLOW CHARACTERISTIC AND THEIR APPLICATION TO CHEMICAL LOADING ESTIMATES,

National Oceanic and Atmospheric Administration Ann Arbor, MI. Great Lakes Environmental Research Lab.

For primary bibliographic entry see Field 2E.
W78-01037

APPLICATION OF ECOSYSTEM MODELING METHODOLOGIES TO DREDGED MATERIAL RESEARCH,

Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Effects, Lab. R. W. Hall, H. E. Westerdahl, and R. L. Eley.

Available from the National Technical Information Service, Springfield, VA 22161 as AD-A027 207, Price codes: A04 in paper copy, A01 in microfiche. Technical Report D-76-3, June 1976. 66 p, 1 tab, 98 ref.

Descriptors: *Aquatic environment, *Ecosystems, *Dredged material, *Mathematical models, Methodology, Bioassay, Dissolved oxygen, Phytoplankton, Disposal, Systems analysis, Water quality.

Identifiers: *Physical models, Dredged material disposal.

Considered is the applicability of physical and mathematical ecosystem modeling methodologies to environmental problems associated with dredging and disposal operations. Three categories of physical models are discussed: bioassays, microcosms, and scaled ecosystem models. Mathematical models can be divided into classes, e.g., those predicting effects of allochthonous loadings on the dissolved oxygen budget or those determining the partitioning and dynamics of chemical constituents. Physical models can be used to quantify effects of environmental perturbations that cannot be adequately studied under field conditions and to serve as data generators and test systems for the development and evaluation of certain types of mathematical models. Physical models are most appropriate where processes are not adequately understood or quantified or where the resulting mathematical relationship are unsolvable with present numerical techniques. Mathematical modeling should be used in summarizing and analyzing large amounts of data and complex interactions to aid in predicting future events. Few model applications have been made to environmental problems related to dredging and disposal operations. Research should include concurrent laboratory, field, and modeling studies. Specific modeling approaches are recommended for research problem areas associated with dredged material disposal: colonization and ecological succession, biological productivity, material cycling, etc. The choice of modeling approach depends on many factors; most existing models will require modification, adaptation, and verification before use. (Bell-Cornell)

W78-01070

ANALYSIS OF STREET SWEEPINGS, PORTLAND, OREGON,

Geological Survey, Oklahoma City, OK. Water Resources Div.

T. L. Miller, J. F. Rinella, S. W. McKenzie, and J. Parmenter.

Open-file report, 1977. 16 p, 1 fig, 2 tab, 8 ref.

Descriptors: *Urban runoff, *Roads, *Dusts, *Chemical analysis, *Water pollution sources, River basins, Oregon, Analytical techniques, Methodology, Data collections.

Identifiers: *Street sweepings, *Portland(Oreg), *Willamette River basin.

Analysis of street sweepings provides data on physical, chemical, and biological characteristics of dust and dirt accumulating on Portland streets. Most of the analyses selected were based on the pollutant loads predicted by the Storage, Treat-

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WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

Identification Of Pollutants—Group 5A

ment, Overflow, and Runoff Model (STORM). Five different basins were selected for sampling, and samples were collected three times in each basin. Sampling plots on streets were selected to reflect different land uses within the basin and different basin sizes. The sweepings from each plot were composited into one bag for the basin. The analytical determinations made for each dust and dirt sample included: total dry sample weight, dry sieving, percent moisture, percent ash, percent settleable solids, biochemical oxygen demand (BOD), total phosphorus, total nitrogen, and indicator bacteria analysis. A few samples were selected for lead and zinc analysis. Subsamples of the <2-mm wet material were placed directly in BOD bottles and mixed with Willamette River water. The Willamette River is the major receiving stream for most of the basins sampled. Therefore, using Willamette water gives some indication of the effect that street material might have on the river water. (Woodard-USGS) W78-01077

ANALYSIS AND CHARACTERIZATION OF SUSPENDED SOLIDS IN PULP AND PAPER MILL EFFLUENT,

B. C. Research Ltd., Vancouver.

E. G-H. Lee, J. C. Mueller, and C. C. Walden.

Canadian Pulp and Paper Association, Technical Section, Environment Improvement Conference, Montreal, October 6-8, 1976, Preprinted Proceedings (Montreal, P.Q.), p 19-25, 4 fig, 8 ref, 6 tab.

Descriptors: *Pulp wastes, *Suspended solids, *Water analysis, Bleaching wastes, Wastes, Industrial wastes, Water pollution sources, Filters, Effluents, Pulp and paper industry, Lime, Filtration, Dissolved solids, Biochemical oxygen demand, Environmental effects, Fish, Toxicity, Waste water(Pollution), Water pollution, Pollutant identification.

Identifiers: Filter paper, Kraft mills, Bleached pulp mills.

Suspended solids values were determined in raw, clarified, and limed and/or biotreated bleached kraft pulp mill effluents. The type of filter paper used in suspended solids analysis affected the suspended solids values. On raw bleached kraft pulp effluents the recommended Whatman GF/C filter (pore size 1.2 micrometers) produced similar total Reeve Angel 202 filter (pore size 25-45 micrometers) produced similar suspended solids values. However, the finer pore size filters produced up to 33 times greater suspended solids values on limed clarified bleached kraft mill effluents, and up to ten times greater values on biotreated bleached kraft mill effluents. The use of the Whatman GF/C or equivalent filter imposes a far more stringent definition of suspended solids on mills with lime neutralization and biotreatment systems than on other mills. The present regulatory analytical procedure was time-consuming when applied to limed and biotreated effluents, because the predominant suspended solids (calcium-lignin and biomass) plugged the filter and reduced filtration rates. Evidence indicated that on lime and biotreated effluents the standard procedure captures dissolved solids, thus distorting suspended solids values. Nonsedimenting solids originating during lime neutralization or biotreatment will settle and degrade slowly in receiving waters. Their 30-day BOD and nutrient loading (N and P) are low. They are not acutely toxic to fish. Thus, the environmental impact of these nonsedimenting solids is believed to be minor. (Swichtenberg-IPC) W78-01102

INSTRUMENTS FOR THE DETECTION OF FIBER CONTENT IN EFFLUENTS AND FOR THE CLASSIFICATION OF RECYCLED FIBROUS MATERIAL,

Swedish Forest Products Research Lab, Stockholm.

L. Eriksson, and J. Hill.

British Paper and Board Industry Federation, Technical Section, Waste Utilization Symposium, Manchester, England, January 22-23, 1975 (Preprinted Proceedings), p 180-198, 10 fig.

Descriptors: *Instrumentation, *Pulp wastes, *Water analysis, *Fibers(Plant), Wastes, Industrial wastes, Water pollution sources, Pulp and paper industry, Effluents, Monitoring, Water quality, Pollutant identification.

The Fiberlog device was developed to continuously monitor the fiber content of paper mill effluents. The feasibility of using this device to monitor fibers in the reject stream from a pulp-cleaning screen is discussed. From data obtained, it is apparent that the Fiberlog can monitor the amount of good fibers in an environment enriched with fines and fillers. Similarly it can monitor the amount of fibers in an environment of shives. The performance of different alternatives for the processing of reclaimed fibers can be evaluated by the Swedish Forest Products Research Laboratory shives analyzer, which can also be used to evaluate the quality of a reclaimed stock in regard to pulp cleanliness. (Sykes-IPC) W78-01113

STUDIES ON LOW MOLECULAR WEIGHT COMPOUNDS IN KRAFT BLEACHING LIQUOR (IN JAPANESE),

Tokyo Univ. (Japan).

K. Kanazawa, S. Hosoya, and J. Nakano.

Japan Tappi, Vol 31, No 7, p 399-403, July, 1977, 8 fig, 2 tab, 4 ref. (English summary).

Descriptors: *Bleaching wastes, *Water analysis, *Organic compounds, *Pollutant identification, Pulp wastes, Pulp and paper industry, Wastes, Industrial wastes, Water pollution sources, Gas chromatography, Mass spectrometry, Lignins, Effluents, Pollutants.

Identifiers: Kraft mills.

Low-molecular weight organic compounds identified in kraft pulp spent chlorination liquor by gas chromatography and mass spectrometry of methylated products included glycolic, fumaric, chloromaleic, and chlorofumaric acid (all originating from lignin). Major unidentified constituents, present in larger amounts than the identified compounds, are probably aliphatic carboxylic acids with conjugated double bonds, including two chloro-organic compounds. The succinic acid which was detected in spent chlorination liquor from unbleached kraft pulp probably derived from a nonlignin component. (Brown-IPC) W78-01117

ASCORBIMETRIC DETERMINATION OF OXYGEN CONTENT IN WATER (ASKORBINOMETRYCZNA METODA OZNACZANIA ZAWARTOSCI TLENU W WODZIE),

Institut Celulozowo-Papierniczy, Warsaw (Poland).

B. Lebska.

Przeglad Papierniczy, Vol 33, No 4, p 123-127, April, 1977, 6 tab, 7 ref. (English summary).

Descriptors: *Water analysis, *Dissolved oxygen, Analytical techniques, Water properties, Water chemistry, Lignins, Activated sludge, Effluents, Pulp and paper industry, Industrial wastes, Oxygen.

Identifiers: *Ascorbimetry, Spent sulfite liquors, Black liquors, Ascorbic acid.

Both the classical Winkler method and the Leithe method (oxidation of ferrous ions to ferric ions and titration of excess ferrous ions with permanganate) for the determination of dissolved oxygen have the drawback of not being applicable to colored solutions because of the difficulty in establishing the end point of titration. This drawback is eliminated in a modified Winkler method, in which titration of iodine is done with ascorbic

acid solution. The procedure of ascorbimetry is described. When applied to distilled water, this method was simple and reproducible, and gave values close to those obtained by the Leithe method and the standard Winkler method. Similar conclusions were reached when the ascorbimetric method was applied to the determination of oxygen in dilute solutions of lignin, spent sulfite liquor, and black liquor. The intense violet color of the indicator makes it possible to use ascorbimetry for the analysis of colored solutions. Further tests of the method are needed in the presence of activated sludge, to determine its applicability to effluents subjected to biological purification. (Stapinski-IPC) W78-01119

DETOXIFICATION OF BLEACHED KRAFT MILL EFFLUENTS -- A MANAGEABLE PROBLEM,

B.C. Research Ltd., Vancouver.

For primary bibliographic entry see Field 5D.

W78-01127

NEW STATE-OF-THE-ART AUTOMATIC MICROELECTROPHORESIS INSTRUMENTATION,

Pen Kem, Inc., Croton-on-Hudson, NY.

J. G. Penniman.

TAPPI Papermakers Conference Papers, Chicago, April 18-20, 1977 (Preprinted Proceedings, TAPPI, Atlanta, Ga.), p 43-48, 8 fig, 1 tab, 9 ref.

Descriptors: *Instrumentation, *Water purification, *Zeta potential, *Electrophoresis, Waste water treatment, Analytical techniques, Colloids, Flocculation, Chemical precipitation, Pulp wastes, Wastes, Industrial wastes, Waste treatment, Water pollution treatment, Water pollution sources, Pulp and paper industry.

An automatic microelectrophoresis analyzer designated the Laser Zeta system 3000 is described. This instrument is capable of providing mean mobility and mobility histogram data for a wide variety of colloids. The advantages of the grating microelectrophoresis analyzer over the laser doppler technique are cited. A description is given of optionally available modules which can provide a variety of sophisticated research and process control functions. Applications of the instrument to control paper machine wet-end chemistry and to improve waste water clarification are discussed. (Witt-IPC) W78-01132

OBSERVATION OF BILINEAR SYSTEMS WITH APPLICATION TO BIOLOGICAL CONTROL,

New South Wales Univ., Kensington (Australia). Dept. of Systems and Control.

D. Williamson.

Automatica, Vol. 13, No. 3, p 243-254, May, 1977, 2 fig, 20 ref.

Descriptors: *Mathematical models, *Equations, *Estimating equations, *Biological treatment, *Microorganisms, Nutrient removal, Monitoring, Model studies, Theoretical analysis, Industrial wastes, Waste water treatment, Growth rates.

A series of bilinear equations are presented to describe the microbial cell growth and product formation of various waste treatment and fermentation systems. The model was developed for use when reliable monitoring devices are not available, to allow on-line estimates of components of biomass, substrate, and product formation other than the total biomass concentration and the concentration of a specific nutrient. Existing models which describe the rate of product synthesis are discussed. The application of the model to a situation in which the growth rate is nonlinear is presented. (Schulz-FIRL) W78-01183

Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5A—Identification Of Pollutants

5B. Sources Of Pollution

PATELLA VULGATA: A BIOLOGICAL MONITOR OF COASTAL METAL POLLUTION - A PRELIMINARY STUDY.
Hebrew Univ., Rehovoth (Israel). Faculty of Agriculture.
For primary bibliographic entry see Field 5A.
W78-00906

CONTENT AND UPTAKE OF TRACE METALS IN BENTHIC ALGAE, ENTEROMORPHA AND PORPHYRA I. MEASUREMENT AND VARIATION OF TRACE METAL CONTENT OF PORPHYRA GROWN IN NATURAL ENVIRONMENT.
Hiroshima Univ., (Japan). Faculty of Fisheries and Animal Husbandry.
T. Fujiyama, and M. Maeda.
Journal of the Faculty of Fisheries and Animal Husbandry, Hiroshima University, Vol. 16, No. 1, p 23-32, 1977. 9 fig, 1 tab, 12 ref.

Descriptors: *Algae, *Distribution, *Metals, *Trace elements, *Benthic flora, *On-site-investigation, Sampling, Analytical techniques, Absorption, Seasonal, *Iron, *Zinc, *Manganese, *Copper, *Lead, *Cadmium, Metabolism.
Identifiers: Bioaccumulation, Porphyra, Tissue analysis, Trace metals.

Trace metals in Porphyra were recovered more than 95% by the treatment of the alga with HNO_3 - $HClO_4$ - HCl . Ten to 20% of the standard deviations were obtained by the analyses of alga. The trace metals in Porphyra were divided into two groups according to their tendencies of seasonal and regional variations, one group being Fe, Zn, Mn, and Cu and the other group, Pb and Cd. The variation of chlorophyll a content was quite similar to that of Fe. The content of metals was different in Porphyra collected from regions other than the fixed stations. (Klein)
W78-00908

TEMPORAL CHANGES IN THE PLANKTON OF AN INDUSTRIALIZED ESTUARY,
University Coll. of Swansea (Wales). Dept. of Zoology.
P. L. Gabriel, N. S. Dias, and A. Nelson-Smith.
Estuarine and Coastal Marine Science, Vol 3, No 2, p 145-151, 1975. 1 fig, 2 tab, 14 ref.

Descriptors: *Plankton, *Oil pollution, *Distribution patterns, *Ecological distribution, Population, Estuaries, Estuarine environment, Seasonal, Water pollution effects, Water pollution sources, Distribution, Environmental effects, Plankton, *Zooplankton, *Phytoplankton.
Identifiers: *Decapods, Milford Haven, Oil ports.

The distribution and seasonal succession of plankton in Milford Haven (Pembrokeshire) was described, in an attempt to detect changes which may have occurred as a result of pollution following the establishment of a major oil port in the estuary. Several species have disappeared or declined since 1960, although replacement species have appeared, and the abundance of plankton in the Haven has not diminished. Changes which have occurred are no greater than might have been produced by natural environmental change and population dynamics. (Katz)
W78-00914

CONTENT AND UPTAKE OF TRACE METALS IN BENTHIC ALGAE, ENTEROMORPHA AND PORPHYRA II. STUDIES ON THE ALGAE CULTURED IN SEA WATER SUPPLEMENTED WITH VARIOUS METALS,
Hiroshima Univ. (Japan). Dept. of Fisheries.
M. Maeda, and T. Fujiyama.
Journal of Faculty of Fisheries and Animal Husbandry, Hiroshima University, Vol. 16, No. 1, p 33-44, 1977. 7 fig, 7 tab, 14 ref.

Descriptors: *Manganese, *Cadmium, *Metals, *Algae, *Benthic flora, *Sea water, *Absorption, Metabolism, Biorhythms, Cycles, Behavior, Water quality, Laboratory tests, Analytical techniques, Plant physiology, Photoperiodism.
Identifiers: Porphyra, Enteromorpha, Bioaccumulation, Tissue analysis.

In the culture of Porphyra in sea water supplemented with metals, the uptakes of Mn and Cd were relatively high and increased in proportion to culture time when the metal concentration in water was high. Fe distributed evenly in all the three parts of fronds. Mn was concentrated in surface and middle layer, while Cd was accumulated mainly in the middle layer and a little in the surface layer. In general the uptake was high in the middle layer. In the uptake of Mn there was a clear distinction between light and dark conditions, that is, Mn was absorbed only during light period while Cd was absorbed regardless of light and dark periods. (Katz)
W78-00924

METHYLATION OF MERCURY IN A TERRESTRIAL ENVIRONMENT,

Environmental Monitoring and Support Lab., Las Vegas, NV.

R. D. Rogers.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-248 221, Price codes: A02 in paper copy, A01 in microfiche. Report EPA-600/3-75-014, October 1975. 13 p, 1 fig, 6 tab, 25 ref.

Descriptors: *Metals, *Mercury, *Organic compounds, *Chemical reactions, *Soil properties, Ions, Soils, Soil texture, Soil moisture, Soil types, Mode of action, Environmental effects, Analytical techniques, Water pollution sources.
Identifiers: *Methylmercury, Terrestrial environment.

Methylation of applied divalent mercury ion was found to occur in terrestrial soil systems. The production of methylmercury was affected by soil texture, soil moisture content, soil temperature, concentration of the ionic mercury amendment, and time. Methylation was directly proportional to percent clay content, moisture content, temperature, and mercury concentration. After an initial buildup of methylmercury in the soil, there appeared to be a mechanism that decreased the methylmercury content with increasing time. (Klein)
W78-00926

TOXICITY TO FISH OF CYANIDES AND RELATED COMPOUNDS - A REVIEW.

Oregon State Univ., Corvallis. Dept. of Fisheries and Wildlife.

For primary bibliographic entry see Field 5C.
W78-00927

TRACE ELEMENT CONCENTRATIONS IN MARINE ORGANISMS FROM THE CAPE WEST COAST,

Atomic Energy Board, Pretoria (South Africa).
D. Van As, H. O. Fourie, and C. M. Vleggaar.
South African Journal of Science, Vol 71 No 5, p 151-154, 1975. 4 tab, 7 ref.

Descriptors: *Heavy metals, *Trace elements, Marine animals, *Marine fish, Marine plants, South Africa, Path of pollutants, Radioactive wastes.

The accumulation of trace elements by marine organisms is an important marine ecological parameter. Radioactive effluent releases to the sea make a knowledge of these concentration factors of the utmost importance. Marine organisms studied in this survey include Chloromytilus meridionalis, Donax serra, Haliotus midae, Jasus lalandii, Pachynus, Pyura, Ulva, Ecklonia, Porphyra,

Suhria and Gigarina. Seventeen species of line, white and pelagic fish were included in the analyses, as well as seawater and plankton samples. Details of sample treatment and the results of analysis for Cr, Fe, Zn, Co, Mn, Sb and Cs are described. (So. African Water Info. Center) W78-00937

ENVIRONMENTAL EFFECTS OF SEPTIC TANK SYSTEMS,

Robert S. Kerr Environmental Research Lab., Ada, OK.

M. R. Scalp, W. J. Dunlap, and J. F. Kreissl.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-272 702, Price codes: A03 in paper copy, A01 in microfiche. EPA-600/3-77-096, Ecological Research Series, August, 1977. 43 p, 11 fig, 4 tab, 22 ref.

Descriptors: *Septic tanks, *Environmental effects, *Water pollution sources, *Sewage disposal, Waste water disposal, Groundwater, Regulation, Design, Groundwater movement, Soil properties, Porosity, Permeability, Human population, Sludge, Leaching.
Identifiers: *Soil absorption fields.

Septic tank-soil absorption systems are the most widely-used method of on-site domestic waste disposal in the U.S., and their total number continues to increase. Because of their widespread use in unsuitable situations, however, they have in many cases demonstrated the potential for contamination of ground and surface waters. Among the reasons for failure of septic tank-soil absorption system to function safely are: (1) unsuitable soils for conventional systems, perhaps in as much as one-half of the U.S. (2) lack of scientific basis for state and local codes governing system design and construction (3) density of population. Proper modification for problem areas and greater attention to zoning and land use planning can greatly reduce the pollution hazards of this valuable waste disposal alternative. Further research into septic system design and movement of pollutants through various types of soils is recommended. (Eberle-NWWA)
W78-00967

HOW RECENT FEDERAL LEGISLATION HAS MOVED TOWARD GREATER PROTECTION OF GROUNDWATER RESOURCES.

Geraghty and Miller, Inc., Port Washington, NY.

For primary bibliographic entry see Field 6E.
W78-00969

EFFECT OF VARIOUS TECHNOLOGICAL FACTORS ON THE COLOR OF PULP MILL EFFLUENTS (WPLYW ROZNYCH CZYNNIKOW TECHNOLOGICZNYCH NA BARWE SCIEKOW POCELUZOZOWYCH),

C. Leszczynski, and J. Zieliński.

Przeglad Papierniczy, Vol. 30, No. 8, p 290-296, August, 1974. 5 fig, 9 tab, 25 ref.

Descriptors: *Pulp wastes, *Sulfite liquors, *Color, *Bleaching wastes, Hydrogen ion concentration, Pulp and paper industry, Chlorination, Industrial wastes.

A review of the pertinent literature shows that studies of the effects of technological, physical, chemical, and biochemical factors on the color of pulping effluents were rather fragmentary, and as a result the industry does not have sufficient data which would allow a proper selection of treatment methods to conform to increasingly strict requirements concerning the color of effluents discharged into waterways. In an attempt to fill existing gaps in this area, the effects of the following factors on the effluent color were determined: pH, concentration, visible and UV radiation, iron salts, chlorine compounds, and biological purification by the activated sludge method. The study was conducted on dilute kraft black liquor and dilute

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WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

Sources Of Pollution—Group 5B

spent sulfite liquor, effluents from chlorination of kraft and sulfite pulps, and effluents from alkaline extraction of these two pulps. Data on the changes in color (degree and direction) resulting from pH variations, dilution, addition of iron salts, etc. make it possible to predict the changes of the color of water in the waterway into which an effluent is discharged. Generally, the pH is an important factor determining the color intensity and as a rule the color intensity increases with the pH. Purification by the activated sludge method does not reduce the color intensity and in some cases may increase it. The removal of color by treatment with chlorine compounds is uneconomical. (Stapinski-IPC) W78-00989

SANITARY LANDFILLS, A BIBLIOGRAPHY, VOLUME 2.

Office of Water Research and Technology, Washington, D.C.
For primary bibliographic entry see Field 5E. W78-01004

RESEARCH ON THE WATER QUALITY OF THE RIVER TARO FROM FORNOVA TO THE MOUTH (IN ITALIAN),
Parma Univ. (Italy).
E. Bellelli, U. Bracchi, and G. Sansebastiano. Ateneo Parmense Acta Nat 12(3): 213-238. 1976. (English summary).

Descriptors: *Organic matter, *Rivers, Phenols, Viruses, Bacteria, Italy.

From Dec. 1972-Nov. 1973 researchers on the water quality of the river Taro, Italy, from beginning of the alluvial cone to the mouth, were performed, with special reference to organic loads, phenols, viral and bacterial concentrations. Between the confluence of the tributary, Ceno, and the S. Quirico bridge, the chemical parameters of organic contamination maintain fairly low levels while the total bacterial count at 20 and at 37 C and the count of total and fecal coliforms appear constantly high. Downstream of the tributary, Stirome, most part of the analytical parameters increase in significant concentrations. Most of the polluted loads (organic matters and phenols) apparently are between the S. Quirico and the Taro mouth, and are mainly conveyed by the Stirome. The bacterial content otherwise is constantly high upstream and exceeds the proposed limits for recreation and bathing use. Along the observed tract of the river, *Salmonellas* were frequently isolated, while viruses only at S. Quirico sampling station.—Copy right 1977, Biological Abstracts, Inc. W78-01016

POLLUTANT TRANSFER INTO WATER BODIES,

Pennsylvania State Univ., University Park. Dept. of Chemical Engineering.

W. J. Brtko, and R. L. Kabel. Water, Air, and Soil Pollution, Vol 6, No 1, p 71-95, August, 1976. 10 fig, 51 ref. EPA-R005168 and EPA-R800397.

Descriptors: *Path of pollutants, *Mass transfer, *Model studies, Diffusion, Dispersion, Turbulence, Flow, Mixing, Reynolds number, Turbulent flow, Eddies, Equations, Air pollution, Air-water interfaces.

Identifiers: *Eddy cell models.

Two mathematical models for determination of the liquid mass transfer coefficient in turbulent fluid were presented as a part of a study on the uptake of atmospheric pollutants by water bodies. The eddy cell model and the large eddy model were compared to determine which was more efficient in predicting the overall liquid phase mass transfer coefficient. This was done on the basis of the Reynolds number (Re) for values of turbulence in the energy containing range. For values of Re less than 60, the use of the large eddy model was

recommended, while for values of Re greater than 425, the eddy cell model was recommended. For intermediate values of Re either model could be used. The drawbacks of the models lie in the fact that they take the friction velocity as being logarithmic, while it actually varies with the wind. Moreover, the models are based on the assumption that the liquid surface remains flat with no wave formation. Thirdly, the models assume the existence of thermal neutrality in the liquid phase. The predicted values of the liquid phase mass coefficient for either model deviate from experimental results. The deviation can vary from 15% when the turbulence can be closely characterized, to 100% when the circumstances in actual field situations must be approximated. (Harris-Wisconsin) W78-01019

WATER POLLUTION INVESTIGATION: LOWER GREEN BAY AND LOWER FOX RIVER,

Wisconsin Dept. of Natural Resources, Madison. Div. of Environmental Standards.

D. J. Patterson, E. Epstein, and J. McEvoy. Available from the National Technical Information Service, Springfield, VA 22161 as PB-245 615. Price codes: A17 in paper copy, A01 in microfiche. Report EPA/905/9-74/017 June 1975. 371 p, 83 fig, 25 tab, 30 ref, 6 append. EPA-905/9-74-017, EPA 68-01-1572.

Descriptors: *Water quality, *Water pollution sources, *Baseline studies, Wisconsin, Rivers, Bays, Algae, Plankton, Nutrients, Nitrogen, Eutrophication, Phosphorus, Dissolved oxygen, Permits, Regulation, Ice cover, Effluents, Industrial wastes, Computer models.

Identifiers: *Green Bay(WI), *Fox River(WI). W78-01024

Descriptors: *Water quality, *Water pollution sources, *Baseline studies, Wisconsin, Rivers, Bays, Algae, Plankton, Nutrients, Nitrogen, Eutrophication, Phosphorus, Dissolved oxygen, Permits, Regulation, Ice cover, Effluents, Industrial wastes, Computer models.

Identifiers: *Green Bay(WI), *Fox River(WI). W78-01024

An extensive survey of water quality in the lower third of Green Bay and the Lower Fox River (WI) was conducted September 1973-September 1974 in connection with enforcement actions against industrial and municipal waste discharges. Fifteen chemical and physical parameters were monitored at 68 sampling sites in Lower Green Bay; effluent information for the Lower Fox, Peshtigo, Oconto, and Menomonee rivers was derived from surveys carried out from 1939-1973. The most critical dissolved oxygen condition occurs during summer low flow in the Lower Fox River, when little or no DO is present. Winter ice cover (January-April), together with high organic loadings and nearly zero reaeration, have caused as much as 150 ppm of lower Green Bay to suffer severe dissolved oxygen (DO) depletion. Long-term biochemical oxygen demand is the prime determinant of the severity of the winter DO deficit. Lake Winnebago is the largest source of nitrogen and phosphorus in the Lower Fox River; ammonia toxicity may continue to be a problem even if treatment plants remove ammonia from effluents. Since nitrification in the river is not substantial, little DO change will result from removing ammonia. Blooms of nitrogen-fixing blue-green algae (*Aphanizomenon*) predominated in July, probably controlled by the phosphorus concentration, which is high in the spring. These algae add large quantities of nitrogen to the bay. Survey results are given in tabular form, along with a description of computer models developed to evaluate discharge permits. (Lynch-Wisconsin)

W78-01022

Descriptors: *Path of pollutants, *Mass transfer, *Model studies, Diffusion, Dispersion, Turbulence, Flow, Mixing, Reynolds number, Turbulent flow, Eddies, Equations, Air pollution, Air-water interfaces.

Identifiers: *Eddy cell models.

Two mathematical models for determination of the liquid mass transfer coefficient in turbulent fluid were presented as a part of a study on the uptake of atmospheric pollutants by water bodies. The eddy cell model and the large eddy model were compared to determine which was more efficient in predicting the overall liquid phase mass transfer coefficient. This was done on the basis of the Reynolds number (Re) for values of turbulence in the energy containing range. For values of Re less than 60, the use of the large eddy model was

METHODS FOR IDENTIFYING AND EVALUATING THE NATURE AND EXTENT OF NON-POINT SOURCES OF POLLUTANTS.

Environmental Protection Agency, Washington, DC. Office of Air and Water Programs.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-257 303. Price codes: A08 in paper copy, A01 in microfiche. EPA-430/9-73-014, October 1973. 269 p, 29 fig, 24 tab, 366 ref.

Descriptors: *Pollutants, *Water pollution sources, *Sediments, *Water pollution, *Water quality, Thermal pollution, Pesticide residues, Agricultural chemicals, Pesticides, Surface waters, Forest management, Agriculture, Mining, Construction, Acid mine water, Nutrients, Evaluation, Groundwater.

Identifiers: *Non-point pollution sources, Acid drainage, Microbial pollution, Pollutant transport.

The study was undertaken to provide documentation of presently available knowledge of the pollution potential to surface and groundwaters from agricultural, silvicultural, construction, and mining activities. The study was concerned with the nature (kinds of pollutants, their sources, and their relative importance) and extent (the magnitude of pollutant emissions: quantities, concentrations) of nonpoint water pollution. Particularly important are factors which relate an emitted pollutant to its source, for the study was designed to assist the planner/engineer in evaluating nonpoint sources of pollutants and their effects on water quality in regional planning areas. The following were investigated as sources of pollution: (1) Agriculture-croplands, grasslands, and livestock; (2) Silviculture-forest culture, harvesting, and logging practices; (3) Mining-new, current, and abandoned surface and subsurface mines, and associated sites and facilities; and (4) Construction-land development, highways and roads, and other heavy construction. (Henley-ISWS) W78-01024

NUMERICAL MODELING OF POLLUTANT TRANSPORT USING A LAGRANGIAN MARKER PARTICLE TECHNIQUE,

Rhode Island Univ., Kingston.

For primary bibliographic entry see Field 5G. W78-01069

ANALYSIS OF STREET SWEEPINGS, PORT-LAND, OREGON,

Geological Survey, Oklahoma City, OK. Water Resources Div.

For primary bibliographic entry see Field 5A. W78-01077

NITROGEN LOADS AND CONCENTRATIONS IN FLORIDA STREAMS,

Geological Survey, Tallahassee, FL. Water Resources Div.

For primary bibliographic entry see Field 7C. W78-01082

WATER AND RELATED PROBLEMS IN COAL-MINE AREAS OF ALABAMA,

Geological Survey, Tuscaloosa, AL. Water Resources Div.

A. L. Knight, and J. G. Newton.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-271 527/AS. Price codes: A04 in paper copy, A01 in microfiche. Water-Resources Investigations 76-130, April 1977. 51 p, 22 fig, 1 tab, 36 ref.

Descriptors: *Water pollution, *Coal mine wastes, *Mine acids, *Sedimentation, *Alabama, Streams, Water quality, Dissolved solids, Sulfates, Hydrogen ion concentration, Hardness(Water), Evaluation, Forecasting, Strip mines, Water pollution sources, Path of pollutants.

Identifiers: Plateau coal field, Warrior coal field, Cahaba coal field, Coosa coal field.

Water-resource problems or potential problems in Alabama resulting from surface and subsurface coal mining include erosion and sedimentation, flooding, diversion of drainage, decline in water level, land subsidence, and the degradation of water quality. The degradation of water quality is the most serious and widespread coal-mine related problem in Alabama. The chemical quality of water in numerous streams draining coal-mine

Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5B—Sources Of Pollution

areas has been altered drastically. The pH of water draining from mined areas commonly ranges from 2.1 to 5.0, generally has high sulfate and dissolved solids concentrations, is hard to very hard, and may contain objectionable amounts of iron. The detrimental quality of water in some streams may persist for decades after mining has ceased. Without proper safeguards, additional mining may cause a significant deterioration in the quality of water in major streams where the more mineralized mine waters are now diluted. (Woodard-USGS)
W78-01094

CLOSING UP KRAFT MILL SYSTEMS — REDUCTION OF EFFLUENTS AND CONTROL OF MATERIAL BALANCES,
Swedish Forest Products Research Lab., Stockholm.
For primary bibliographic entry see Field 3E.
W78-01108

THE ROLE OF TOXIC COMPOUNDS IN THE REVISION OF THE 1983 EFFLUENT GUIDELINES,
Environmental Protection Agency, Washington, DC.
For primary bibliographic entry see Field 6E.
W78-01122

OUTFALL DIFFUSER SYSTEMS — DESIGN AND INSTALLATION,
Simons (H. A.) International Ltd., Vancouver (British Columbia).
For primary bibliographic entry see Field 8B.
W78-01126

TOXICITY, BOD, AND COLOUR OF EFFLUENTS FROM THE KRAFT PULPING OF BOLE WOOD CONTAINING HIGH QUANTITIES OF BARK,
Pulp and Paper Research Inst. of Canada, Pointe Claire (Quebec).

A. Wong.
TAPPI Environmental Conference Papers, Chicago, April 25-27, 1977, (Preprinted Proceedings, TAPPI, Atlanta, Ga.), p 89-97. 4 fig, 5 tab, 21 ref.

Descriptors: *Pulp wastes, *Bark, *Toxicity, *Color, *Biochemical oxygen demand, *Effluents, Pulp and paper industry, Wastes, Industrial wastes, Chemical oxygen demand, Hardwood, Softwood, Effluents.

Identifiers: *Kraft pulping, Black liquors, Trembling aspen(*Populus tremuloides*), Black spruce(*Picea mariana*), Jack pine(*Pinus banksiana*), Western red-cedar(*Thuja plicata*).

Kraft pulping of *Populus tremuloides*, *Picea mariana*, *Pinus banksiana*, and *Thuja plicata* wood without and with 15% bark was studied under single set of pulping conditions (e.g., effective alkali and sulfide based on wood and total H-factor) for a given species. No attempts were made to optimize the pulping of wood with bark by varying the pulping conditions. Preliminary results indicated that the toxicities of black liquors from trembling aspen, black spruce, and western red-cedar increased significantly when the wood contained bark. There was no detectable difference in the toxicity of black liquor between pulping 100% jack pine and pulping jack pine with bark. BOD and COD loadings of the simulated brown stock decker filtrate did not appear to be increased markedly by the pulping of wood and bark mixtures. However, color loadings were increased by an average of 65% for the four species. (Witt-IPC)
W78-01128

EFFECTS OF URBAN LAKES ON SURFACE RUNOFF AND WATER QUALITY,
Wisconsin Univ.-Milwaukee. Dept. of Geological Sciences.

For primary bibliographic entry see Field 2E.
W78-01135

WATER POLLUTION CAUSED BY INACTIVE ORE AND MINERAL MINES - A NATIONAL ASSESSMENT.

Toups Corp. Santa Ana, CA.

H. W. Martin, and W. R. Mills, Jr.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-264 936, Price codes: A09 in paper copy, A01 in microfiche. EPA-600/2-76-298. December 1976. 195 p, 17 fig, 15 tab, 4 append.

Descriptors: *Water pollution sources, *Mine drainage, *Mine wastes, *Mine acids, *Mining, Metals, Erosion control, Slope protection, Sediment control, Regional analysis, Environmental effects, Pollution abatement, Industrial wastes.

A 12-month study was conducted between July 1975 and July 1976 to identify the extent of water pollution caused by inactive mines, define present water pollution abatement technology, and examine the use and effectiveness of current waste water treatment methods. The study indicated that 70% of the associated streams were affected by acid mine drainage (AMD) and heavy metals and 50% were affected by sedimentation. Economic geology and production methods are discussed, including mining, mineral processing, processing technology for major commodities, and waste disposal and production. Factors affecting acid and metals in receiving waters are discussed, including natural buffering systems in stream systems, sulfate as an indication of AMD, and transportation and removal of pollutants in streams. Studies on toxicities and biological effects of pollutants are examined with respect to aquatic life and municipal and agricultural uses. A national summary of the impact of mining is presented. Existing types of control technology which are assessed include infiltration control, retention and regulation of mine drainage, treatment of AMD, erosion prevention, and sedimentation basins. Research and development is suggested for the effects of mine drainage on groundwater quality, assessment of mercury in surface waters from gold milling, improvement of pollution monitoring techniques, chemistry related to mine drainage, air and erosion prevention technology, natural mineral formations as traps for dissolved ions, botanical treatment, physical chemical treatment, and the effects of mining techniques on pollution control. (Schulz-FIRL)
W78-01158

FOLLOW-UP INVESTIGATION ON CYANIDE COMPLEX DETECTED FROM PULP SLUDGE (SEISI SURAGI KARA KENSUTSU SARETA SHIAN KAGOBUTSU NI TSUITE NO TSUISEKI CHOSA),

Shizuoka Prefectural Inst. of Public Health (Japan).

T. Nagano, S. Hattori, T. Nagai, Y. Uchimura, and C. Unno.
Eisei Kagaku, Vol. 23, No. 2, p 121-124, 1977. 1 fig, 3 tab, 8 ref.

Descriptors: *Pulp wastes, *Pulp and paper industry, *Analytical techniques, *Nitrogen compounds, Organic wastes, Chemical wastes, Path of pollutants, Industrial wastes, Waste water treatment.

Identifiers: Cyanide, Ink.

Various parameters were measured in pulp wastes sampled from June 1973 to June 1974 at a location which receives discharges from many pulp and paper industries in Fuji City, Japan. Soluble and percolated solutions of the sludges were analyzed for color, pH, COD, BOD, total mercury, lead, cyanide, and PCB. Cyanide ion concentrations were measured in pulp sludges obtained from nine factories. Significant levels of cyanide were detected in four of the sludges and the values ranged

from 0.01 to 5.3 ppm. Additional analyses were performed for samples collected at various points within the factory having the highest cyanide concentration, and values obtained with the pyridine-pyrazolone and ion-electrode methods were compared. The analyses indicated that the highest cyanide levels are expected in the pulp sludge and in pulp produced from waste paper without prior removal of the ink. The de-inking, aggregation, and sedimentation processes resulted in cyanide concentration in the sludge. (Schulz-FIRL)
W78-01174

5C. Effects Of Pollution

TOXICITIES OF 'EXCESSIVELY' CHLORINATED ORGANIC COMPOUNDS,

Florida Inst. of Tech., Melbourne. Dept. of Biological Sciences.

B. M. Katz, and G. M. Cohen.

Bulletin of Environmental Contamination and Toxicology, Vol. 15, No. 6, p 644-650, 1976. 5 fig, 1 tab, 1 ref.

Descriptors: *Toxicity, *Organic compounds, *Chlorine, *Chlorination, *Water chemistry, Farm wastes, Industrial wastes, Chemical reaction, Water pollution sources, Mortality, Phenols, Fish physiology, Bioassay, Water treatment, Water quality, Sewage treatment.

Identifiers: *Mosquito fish, Gambusia, Tryptophan, Tannic acid.

Chemical tests were performed on several classes of common compounds before and after excessive chlorination to determine whether such treatment could transform relatively innocuous substances into toxic ones or potentiate pre-existing toxicities. Chlorination caused phenol and tryptophan to become exceedingly toxic to mosquito fish. In addition, fish placed in excessively chlorinated tap water (10 ppm) quickly died. The excessive Cl apparently reacted with the fish bodies to form one or more stable and highly toxic organochlorine compounds as evidenced by the continued toxicity of the test water after the elimination of the residual chlorine. In contrast to tryptophan and phenol, excessive chlorination of tannic acid reduced toxicity. The toxicity of 14 other diverse compounds was unaltered by excessive chlorination. (Katz)
W78-00901

EGG MORTALITIES IN WILD POPULATIONS OF THE DUNGENESS CRAB IN CENTRAL AND NORTHERN CALIFORNIA,

California Univ., Bodega Bay. Bodega Marine Lab.

W. S. Fisher, and D. E. Wickham.

Fishery Bulletin, Vol. 75, No. 1, p 235-237, 1977. 1 tab, 6 ref.

Descriptors: *Crabs, *Mortality, *Embryonic growth stage, *Nutrients, Biological membranes, Water pollution effects, Pathology, Commercial shellfish, Crustaceans, Growth stages, Animal physiology, California, Commercial shellfish.

Identifiers: Cancer, *Epibiotic fouling, Dungeness crab, Crab eggs.

Crab eggs were sampled from four regions of the California Coast. The samples were then used to compute peripheral and overall mortality estimates for each region. The results were consistent between regions except for the area closest to San Francisco Bay, which had much higher mortalities. Earlier research by the authors suggested that nutrients from S.F. Bay were carried northward by the prevailing coastal current causing an increase in epibiotic fouling which restricted gaseous exchange across the egg membrane and increased egg mortalities. (Katz)
W78-00902

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WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

Effects Of Pollution—Group 5C

SWAN MORTALITY DUE TO CERTAIN HEAVY METALS IN THE MISSION LAKE AREA, IDAHO,
Idaho State Dept. of Health and Welfare, Boise. Community Study on Pesticides.

W. W. Benson, D. W. Brock, J. Gabica, and M. Loomis.
Bulletin of Environmental Contamination and Toxicology, Vol. 15, No. 2, p. 171-174, 1976. 1 tab, 11 ref.

Descriptors: *Heavy metals, *Mine wastes, *Lead, *Swans, *Whistling swan, *Toxicity, *Mortality, Spectrophotometry, Pollutants, Animal physiology, Water birds, Pathology, Water pollution effects, Analytical techniques, Idaho. Identifiers: Tissue analysis, *Lead poisoning.

Thirteen swans found dead were autopsied and their tissues were analyzed for lead. All swans exhibited typical signs associated with lead poisoning. Lead residues in bone was indicative of chronic exposure. The intestinal tracts had a blue-gray or greenish cast, which denotes the presence of lead sulfide. Only one bird had lead shot in the gizzard indicating that these birds did not die from ingestion of pellets. It appears that high lead levels were related to ingestion of vegetation which was contaminated with lead. (Katz) W78-00903

FENITROTHION TOXICITY TO THE FRESH-WATER CRAYFISH, ORCONECTES LIMOSUS,
Fisheries and Marine Service, St. Andrews (New Brunswick). Biological Station.

D. W. McLeese.
Bulletin of Environmental Contamination and Toxicology, Vol. 16, No. 4, p. 411-416, 1976. 2 tab, 10 ref.

Descriptors: *Toxicity, *Mortality, *Lethal limit, Pesticides, *Lobsters, *Crayfish, *Organophosphorus pesticides, Phosphothioate pesticides, *Pesticide toxicity, *Pesticide kinetics, Crustaceans, Shellfish, Water pollution effects. Identifiers: *Fenitrothion, Orconectes.

Fenitrothion has been routinely used as an aerial forest spray for spruce budworm control. Following spraying, concentrations of up to 4.8 ppb were found in streams. This study attempted to ascertain whether the sensitivity of the freshwater crayfish to Fenitrothion was as extreme as related to marine crustaceans. It was determined that there is a definite size effect, the large crayfish having longer resistance times at a particular lethal concentration and having a higher lethal threshold than small ones. The lethal threshold values were 4 ppb for small and 20 ppb for large crayfish, values much higher than those for the lobster. (Katz) W78-00904

RELATIONSHIPS BETWEEN THE BIVALVE MACOMA BALTHICA AND BACTERIA IN INTERTIDAL SEDIMENTS: MINAS BASIN, BAY OF FUNDY,
McMaster Univ., Hamilton (Ontario). Dept. of Geology.

V. Tunnicliffe, and M. J. Risk.
Journal of Marine Research, Vol. 35, No. 3, p. 499-507, 1977. 2 fig, 1 tab, 37 ref.

Descriptors: *Intertidal areas, *Littoral, *Tidal effects, *Benthic fauna, *Sediments, Particle size, Population, *Bacteria, Density, Variability, *Biological communities, Sediment-water interfaces, *Bottom sediments, Nitrogen, Molluscs, *Public health, *Clams. Identifiers: Macoma, *Bay of Fundy.

The extensive intertidal flats of the Minas Basin, Bay of Fundy, support some of the highest population densities of Macoma balthica ever recorded. Densities were positively correlated with density of bacteria in the sediment; correlations with tidal

elevation and organic carbon content of the sediment were not significant. Macoma density appeared to be related to the amount of fine material present in the sediment. Although Macoma feeds on the bacteria within the sediment, it must supplement its diet by suspension-feeding during high tide in order to acquire sufficient protein. (Katz) W78-00905

QUANTITATIVE STUDIES ON MARINE BIODEGRADATION OF OIL. III. COMPARISON OF DIFFERENT CRUDE OIL RESIDUES AND EFFECTS OF SEA WATER SOURCE,
University Coll. of North Wales, Menai Bridge. Marine Science Labs.

S. J. Davis, C. F. Gibbs, and K. B. Pugh.
Environmental Pollution, Vol. 13, p. 203-215, 1977. 5 fig, 3 tab, 5 ref.

Descriptors: *Oil, *Oil pollution, *Nitrogen, *Nitrogen compounds, *Nitrates, *Nutrient removal, *Biodegradation, *Microbial degradation, *Oxygen demand, *Oxidation, *Chemical degradation, Laboratory equipment, Persistence, Water pollution, Analytical techniques, Chemical analysis, Temperature.

Identifiers: Respirometer, *Crude oil residues, Kuwait crude oil, North Sea crude oil.

A respirometric method, which had been used previously for studying the degradation of Kuwait crude oil residue in local sea water, was used again with two different crude oil residues as substrates. However, the differences found appeared to be due mainly to the sample of sea water rather than to the type of oil. This may be due to microbial adaption to the nutrient regimes of winter sea water contrasted with summer sea water. The supply of available nitrogen appeared to be the limiting factor at any given temperature, as was the case in the earlier work, but nitrate was not reduced to such very low concentrations. Also in comparison with this earlier work, there was rather less oxygen uptake in proportion to nutrient uptake, particularly at the higher temperature, temperature having less effect on this relationship. About half of each crude oil residue appeared almost undegradable. Similar changes in oil properties occurred, but in the case of Forties (North Sea) oil residue, the relative density did not come to exceed that of sea water. Further work is required to find whether degradation and other weathering processes will eventually cause it and other North Sea oils to sink. (Katz) W78-00917

CONTENT AND UPTAKE OF TRACE METALS IN BENTHIC ALGAE, ENTEROMORPHA AND PORPHYRA I. MEASUREMENT AND VARIATION OF TRACE METAL CONTENT OF PORPHYRA GROWN IN NATURAL ENVIRONMENT,
Hiroshima Univ., (Japan). Faculty of Fisheries and Animal Husbandry.

For primary bibliographic entry see Field 5B. W78-00908

USE OF SALT (NaCl) WATER TO REDUCE MORTALITY OF CHINOOK SALMON SMOLTS, ONCORHYNCHUS Tshawytscha, DURING HANDLING AND HAULING,
National Marine Fisheries Service, Seattle, WA. Northwest Fisheries Center.

For primary bibliographic entry see Field 5G. W78-00909

TEMPORAL CHANGES IN THE PLANKTON OF AN INDUSTRIALIZED ESTUARY,
University Coll. of Swansea (Wales). Dept. of Zoology.

For primary bibliographic entry see Field 5B. W78-00914

EFFECT OF CHRONIC EXPOSURE OF BROOK TROUT TO SUBLETHAL CONCENTRATIONS OF HYDROGEN CYANIDE,
Minnesota Univ., St. Paul. Dept. of Entomology, Fisheries and Wildlife.

W. M. Koenst, L. L. Smith, Jr., and S. J. Borderius.
Environmental Science and Technology, Vol 11, No 9, p 883-887, 1977. 4 tab, 17 ref.

Descriptors: *Brook trout, *Toxicity, *Mortality, *Growth stages, *Spawning, Fish eggs, Juvenile growth stage, Fecundity, Fertility, Trout, Salmonids, Water pollution effects, Path of pollutants, Laboratory tests, Laboratory equipment, Bioassay.

Identifiers: *Hydrogen cyanide, *Cyanide, Sublethal concentrations, Continuous flow, Bioassay.

Brook trout, *Salvelinus fontinalis* (Mitchell), were exposed to various concentrations of hydrogen cyanide to determine the effects of continuous exposure on survival, growth, and reproduction. Continuous flow experiments were begun with adults 144 days prior to spawning and were continued through a 90-day growth period of the second generation. The maximum acceptable toxicant concentration (MATC) of hydrogen cyanide was between 5.7 and 11.2 micro g/l based on the spawning data. (Katz) W78-00915

THE INFLUENCE OF AMMONIA ON THE OXYGEN DELIVERY SYSTEM OF COHO SALMON HEMOGLOBIN,
Rhode Island Univ., Kingston. Dept. of Animal Science.

R. J. Sousa, and T. L. Meade.
Comparative Biochemistry and Physiology, Vol 58A, p 23-28, 1977. 3 fig, 4 tab, 29 ref.

Descriptors: *Oxygen, *Ammonia, *Respiration, *Oxygen requirements, *Salmon, *Acid-base equilibrium, *Hydrogen ion concentration, Spectrophotometry, Nitrogen compounds, Metabolism, Fish physiology, Growth stages, Bioassay, Toxicity, Carbohydrates.

Identifiers: Hemoglobin, Glycolysis.

Prolonged exposure of coho salmon to elevated levels of environmental ammonia causes a progressive acidemia which, sequentially, has a negative effect on the oxygen carrying capacity of the blood pigment - hemoglobin. The toxic effect is induced by accumulation of acid metabolites brought about by an enzymatic stimulation of glycolysis by NH4+ and the simultaneous suppression of TCA cycle activity. As HCO3- is removed from the blood system to neutralize excess hydrogen ions generated by these acids, the ratio between HCO3- and PCO2 is distributed and the blood pH decreases. The resulting acidemia causes oxygen to be prematurely released from hemoglobin by abnormally shifting the equilibrium curve to the right and simultaneously reducing the maximum saturation of hemoglobin for oxygen. If the oxygen tension in the external environment is not immediately increased to compensate for the shift in the equilibrium curve, or if the ammonia stress is not diminished, the organism is susceptible to death by suffocation. (Katz) W78-00916

A SALTWATER FLOW-THROUGH BIOASSAY METHOD WITH CONTROLLED TEMPERATURE AND SALINITY,
Environmental Research Lab., Gulf Breeze, FL.

For primary bibliographic entry see Field 5A. W78-00917

ROLE OF UN-IONIZED AMMONIA IN PREDISPOSING GILL APPARATUS OF ALBURNUS ALBURNUS ALBORELLA TO FUNGAL AND BACTERIAL DISEASES,
Istituto Italiano di Idrobiologia, Palianza.

Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5C—Effects Of Pollution

G. Giussani, I. Borroni, and E. Grimaldi.
Memorie dell'Istituto Italiano di Idrobiologia,
Vol 33, p 161-175, 1976. 11 fig, 1 tab, 29 ref.

Descriptors: *Mortality, *Ammonia,
*Myxobacteria, *Fish diseases, *Eutrophication,
*Pathogenic bacteria, *Pathogenic fungi, Water
pollution effects, Organic matter, Pathology, Bacteria,
Fishkill, Fish populations, Fungi.
Identifiers: *Tissue analysis, *Bleak, *Alburnus*,
Brachionymus, Gill disease, Lake Maggiore(Italy).

Mass mortalities of fungal and bacterial origin occurring in bleak population (*Alburnus alburnus* albovittata) in Lago Maggiore (Northern Italy) did coincide with very sharp peaks of un-ionized ammonia. It was hypothesized that the pathogenic conditions observed in the bleak were not due to a direct toxic action of un-ionized ammonia but rather were attributable to its noxious stimulus role. This action predisposed the gill apparatus to the attack of different pathogens. Possible relationships with the eutrophication process were also discussed. (Katz)
W78-00918

ACUTE TOXICITY OF FOUR ORGANOPHOSPHORUS INSECTICIDES TO A FRESHWATER TELEOST *CHANNA PUNCTATUS* (BLOCH),
University of the Panjab, Lahore (Pakistan). Dept. of
Zoology.
M. A. Anees.
Pakistan Journal of Zoology, Vol 7, No 2, p 135-141, 1975. 4 fig, 2 tab, 29 ref.

Descriptors: *Bioassay, *Toxicity,
*Organophosphorus pesticides, *Insecticides,
*Diazinon, Teleosts, Pesticides, Lethal limit,
Freshwater fish, Water pollution effects, Water
pollution sources, Environmental effects, Fishkill.
Identifiers: *Malathion, *Parathion, *Dimethoate,
Channa.

Static bioassays were carried out to determine the acute toxicity of four organophosphorus insecticides to a freshwater teleost *Channa punctatus* (Bloch). 96-hr median tolerance limit (TLM) was in the following orders; diazinon (0.455 ppm), malathion (0.920 ppm), methyl parathion (2.150 ppm), and dimethoate (20.500 ppm). Behavioral symptoms of acute intoxication in fish were similar to those reported to appear after inhibition of acetylcholinesterase by organophosphates. Mechanism of death by, and variations in species susceptibility to organophosphorus insecticides were discussed. (Katz)
W78-00919

PHYTOPLANKTON, PHYTOPLANKTON GROWTH AND BIOMASS CYCLES IN AN UNPOLLUTED AND IN A POLLUTED POLAR LAKE,
J. Kalf, H. J. Kling, S. H. Holmgren, and H. E. Welch.
Verhandlungen Internationale Verein fur theoretische und angewandte Limnologie, Vol. 19, p 487-495, 1975. 6 fig, 1 tab, 14 ref.

Descriptors: *Phytoplankton, *Growth rates,
*Biomass, *Seasonal, *Eutrophication,
*Oligotrophy, Aquatic microorganisms, Population,
Biological communities, Lake ice, Lake
stages, Lakes, Water pollution effects, Sewage,
Domestic wastes, Phytoplankton, Biomass.
Identifiers: Ultraoligotrophic lakes, Char Lake,
Meretta Lake.

This paper compared the biomass and biomass cycles as well as community and some species growth rates in ultraoligotrophic Char Lake and sewage polluted Meretta Lake (Canada). The phytoplankton biomass varied 5.5 fold between a low of 30 mg m⁻³ close to the end of the polar night and a summer maximum of 166 mg m⁻³ in unpol-

luted Char Lake and ranged 63 fold in sewage polluted Meretta Lake where the equivalent range was between 104 and 6560 mg m⁻³ during the May 1969 to March 1971 study period. The maximum Char and Meretta Lake biomass values indicate that Char Lake is ultraoligotrophic and Meretta Lake is mildly eutrophic. Maximum community growth rates (k) computed from primary production rates and biomass are quite similar at approximately 0.13 and 0.17, respectively, in the ultraoligotrophic and the polluted lake and indicate a similar metabolic activity per cell. (Katz)
W78-00920

EFFECTS OF BURROWING TUBIFICID WORMS ON THE EXCHANGE OF PHOSPHORUS BETWEEN LAKE SEDIMENT AND OVERLYING WATER,
R. B. Davis, D. L. Thurlow, and F. E. Brewster.
Verhandlungen Internationale Verein fur theoretische und angewandte Limnologie, Vol. 19, p 382-394, 1975. 10 fig, 5 tab, 17 ref.

Descriptors: *Phosphorus, *Radiochemical analysis,
*Tracers, *Phosphorus, Radioisotopes,
*Tubificids, Bottom sediments, *Lake sediments,
*Sediment-water interfaces, Radioactivity techniques,
Worms, Aquatic animals, Bottom sampling,
Chemical analysis, Eutrophication, Productivity.
Identifiers: *Bioturbation.

Radioactive phosphoric acid introduced into water overlying undisturbed sediment was taken up rapidly by the sediment where most of the 32P became aluminum- and iron-bound. Tubificids accelerated the decrease of 32P in the water and the depth of penetration of the sediment, but much of the mobility of 32P was due to diffusion. Release of 32P from the sediment to overlying water with or without oxygen occurred but was impeded near the interface especially when oxygen was present. The worms did not affect the release of 32P to the water. The worms reduced the proportion of PO4³⁻ in the interstitial water of the uppermost sediment, probably due to their effect of increasing Eh there. However, most of the mobile-32P was in some form other than PO4³⁻ which was probably redox-insensitive. The moderate effects in these experiments probably reflect the moderate populations of worms used. Under some eutrophic conditions, populations in excess of 10,000/m² occur. (Katz)
W78-00921

ECOLOGICAL ASPECTS OF COOLING WATER DISCHARGES. (IN SWEDISH),
Entomol. Avd., Uppsala, Swed.
Ulf. Grimas.
Fauna Flora (Stockh) 70(2): 50-55, 1975. (English summary).

Descriptors: *Cooling water, *Heated water,
Nuclear powerplants, *Environmental effects, Organic matter, Discharge(Water).

The heat of the cooling water from fossil fueled and nuclear power plants might lead to serious effects in the environment. There is a direct local effect on the activity of organisms and on the combination of species in the communities, which affects the catchability of fish. The increased temperature stimulates the incorporation of toxic matter as heavy metals and biocides in organic material, leading to a conservation of products in the waters, which cover a much larger area than heat itself. Negative effects in a regional scale can also be apprehended by the favorable effects of heat on fish parasites and diseases. The heat increases the rate of decomposition of organic matter in the receiving water and the induced flow of water permits transportation of, e.g., O2. Management of cooling water systems requires detailed information on the ecological function of the affected water body and an increased experience of synergistic effects. (Copyright 1977, Biological Abstracts, Inc.)

W78-00922

RESIDUE ANALYSES ON 2-AMINO-4-PHENYLTHIAZOLE, A PISCINE ANESTHETIC, IN FISHES - III METABOLISM IN RAINBOW TROUT AND CARP,
Meiji Seiki Kaisha Ltd., Yokohama (Japan). Research Labs.
For primary bibliographic entry see Field 5A.
W78-00923

CONTENT AND UPTAKE OF TRACE METALS IN BENTHIC ALGAE, ENTEROMORPHA AND PORPHYRA II. STUDIES ON THE ALGAE CULTURED IN SEA WATER SUPPLEMENTED WITH VARIOUS METALS,
Hiroshima Univ. (Japan). Dept. of Fisheries.
For primary bibliographic entry see Field 5B.
W78-00924

EFFECT OF HYDROGEN SULFIDE ON FISH AND INVERTEBRATES PART II-HYDROGEN SULFIDE DETERMINATION AND RELATIONSHIP BETWEEN PH AND SULFIDE TOXICITY,
Minnesota Univ., St. Paul, MN. Dept. of Entomology, Fisheries and Wildlife.
S. J. Broderius, and L. L. Smith, Jr.
Report EPA-600/3-76-0626, 1976. 109 p, 3 fig, 17 tab, 65 ref, append.

Descriptors: *Analytical techniques,
*Methodology, *Hydrogen sulfide, *Hydrogen ion concentration, *Toxicity, *Freshwater fish,
*Minnows, Temperature, Mortality, Bioassay, Colorimetry, Equilibrium, Environmental effects, Water properties.
Identifiers: *Fathead minnows.

Analytical techniques were used to define the relationship between pH and sulfide toxicity to the fathead minnow. Within the pH range of 7.1 to 8.7, 96-hr LC₅₀ values for molecular H₂S decreased linearly from 57.3 to 14.9 micro g/liter with increasing pH. However, the log 96-hr LC₅₀ values of dissolved sulfide increased linearly from 64.0 to 780.1 micro g/liter with increasing test pH ranging from 6.5 to 8.7. (Katz)
W78-00925

METHYLATION OF MERCURY IN A TERRESTRIAL ENVIRONMENT,
Environmental Monitoring and Support Lab., Las Vegas, NV.
For primary bibliographic entry see Field 5B.
W78-00926

TOXICITY TO FISH OF CYANIDES AND RELATED COMPOUNDS - A REVIEW,
Oregon State Univ., Corvallis. Dept. of Fisheries and Wildlife.
P. Doudoroff.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-253 528. Price codes: A08 in paper copy, A01 in microfiche. Report No. EPA-600/3-76-038, April 1976. 154 p, 123 ref.

Descriptors: *Nitrogen compounds, *Toxicity,
*Lethal limit, *Water quality standards, *Water pollution effects, *Path of pollutants, *Fish physiology, *Fish behavior, Hydrogen ion concentration, Temperature, Animal growth, Dissolved oxygen, *Bibliographies, *Reviews.
Identifiers: *Cyanides, *Nitriles, Cyanogen chloride, Thiocyanates, *Cyanates, Sublethal effects.

The world literature on the toxicity to fish of simple and complex cyanides, nitriles, cyanogen chloride, thiocyanates, and cyanates was reviewed critically and interpretively. Differently determined limits of toxicant concentrations tolerated by various fishes were compared, and

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WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

Effects Of Pollution—Group 5C

their variation with exposure time, the pH, temperature, and dissolved oxygen and mineral content of the water, body size, age, acclimation, etc. was examined. Interactions of free cyanide with other toxic water pollutants also were considered. Available data on effects of sublethal levels of free cyanide on growth, food consumption and utilization, swimming ability, behavior, etc., and observations on avoidance reactions of fish to the toxicant were summarized and their ecological significance were discussed. (Katz) W78-00927

ALGAL BIOASSAYS AND NITROGEN FIXATION,

National Inst. for Water Research, Pretoria (South Africa).

For primary bibliographic entry see Field 5A.

W78-00940

THE USE OF THE ISOTOPE 32P IN THE STUDY OF SOME ECOLOGICAL ASPECTS OF A LABORATORY STREAM ECOSYSTEM (IN AFRIKAANS),

Randse Afrikaanse Univ., Johannesburg (South Africa). Navorsingsgroep vir Varswaterbiologie.

For primary bibliographic entry see Field 5A.

W78-00945

SPECTROFLUOROMETRIC DIFFERENTIATION OF THE RED TIDE ALGA, GONYAULAX TAMARENSIS FROM OTHER ALGAE COMMON TO NEW ENGLAND WATERS,

Massachusetts Inst. of Tech., Cambridge.

S. Ezekiel, B. Kerfoot, and G. White.

Massachusetts Institute of Technology Sea Grant Report No. MITSG-77-18, Index No. 77-318-Efw, September 1977. 56 p, 24 fig, 2 tab, 17 ref, append. SG-04-6-158-44081.

Descriptors: *Red tide, *Algae, Toxins, Pollutant identification, *Shellfish, Monitoring, New England.

Identifiers: Spectrofluorometry, Gonyaulax tamarensis, Shellfish poisoning, Saxitoxin.

Cultures of *Gonyaulax tamarensis* were subject to spectrofluorometric analyses for discrimination from common endemic algae of the New England area for possible use in an airborne spectrofluorometric system. Extracts of *G. tamarensis* and other dinoflagellates display a fluorescence emission different from other algae tested. Live cultures did not display the unique emission with a laser of excitation source limited frequencies. Detection limits of *G. tamarensis* by chlorophyll a determination is 60 cells per milliliter in live cultures. (NOAA) W78-00950

THE RIVER SKAWA: WATER CHEMISTRY AND EUTROPHICATION, (IN POLISH),

Polish Academy of Sciences, Warsaw. Dept. of Hydrobiology.

For primary bibliographic entry see Field 2K.

W78-00990

NITROGEN YIELD COEFFICIENT OF THE GREEN ALGA, SELENASTRUM CAPRICORNUTUM PRINTZ,

National Inst. for Water Research, Pretoria (South Africa).

D. F. Toerien, D. J. Steyn, and S. I. Kohlmeyer. South African Journal of Science, Vol 71, p 217-218, July 1975. 1 fig, 1 tab.

Descriptors: Algal growth, Algae bioassay, Eutrophication, Algal cultures, Algae yield, Dams, Growth curve, Nitrogen yield coefficient, Nitrogen phosphorus ratio, Phosphorus, Nitrogen. Identifiers: *Selenastrum capricornutum*, Hartebeestpoort, Rietvlei, Roodeplaat, Vaal dam, South Africa.

Algal bioassays carried out during studies on the eutrophication levels of the Hartebeestpoort, Roodeplaat, Rietvlei and Vaal dams provided data from which the nitrogen yield coefficient could be estimated, and the growth curves of *S. capricornutum* under nitrogen limiting conditions could be predicted. (So. African Water Info. Center) W78-01000

PRELIMINARY RESULTS OF A SURVEY OF FRESHWATER NEMATODES IN SOUTH AFRICA,

Randse Afrikaanse Univ., Johannesburg (South Africa).

J. Heyns.

Journal of the Limnological Society of Southern Africa, Vol. 2, No. 2, p 43-45, 1976. 5 tab, 1 ref.

Descriptors: Nematodes, Freshwater biology, Aquatic habitat, Species composition, Species diversity, Species abundance, Water pollution, Frequency distribution.

Identifiers: South Africa, *Tobrilus*, *Monhystera*.

An extensive survey of the freshwater nematodes of South Africa was initiated in 1973, and 170 samples have been processed to date. Of these 107 came from the Vaal Triangle, the other 63 from rural areas in the Transvaal (Rustenburg, Groblersdal and Nelspruit/Barberton), the Vaal River in the Parys area, the Eastern Cape Province in the vicinity of Port Elizabeth and Humansdorp, and the Western Cape Province from Hermanus to Clanwilliam. Preliminary results revealed that most habitats yield relatively small numbers of species, and that this tendency is more pronounced in polluted areas. Whereas the incidence of most nematode groups showed a marked decrease under polluted conditions, the genera *Tobrilus* and *Monhystera* appeared to thrive in these areas. (So. African Water Info. Center) W78-01020

RECENT EVOLUTION OF THE DIFFERENT LEVELS OF MARINE POLLUTION OF THE SOFT SUBSTRATUM LINKED WITH THE BIG SEWER OF MARSEILLE-CORTIOU. (IN FRENCH),

G. Bellan, R. A. Kaim-Malka, and J. Picard. Bull Ecol 6(2): 57-66. 1975. (English summary).

Descriptors: *Marine animals, *Water pollution effects, France, *Sewers, Outlets.

The marine populations established on the soft substratum near the sea outlet of the big sewer of the city of Marseilles (France) have shown considerable modification during the last 3 yr. The classical effect of pollution (the effect on the level of populations by a large extension of the so-called subnormal area) is joined to a deflector effect. The construction of a stable and extended flow of detritus modified the currents on the bottom and removed some populations (e.g., *Leptometra phalangium*).—Copyright 1977, Biological Abstracts, Inc. W78-01015

EUTROPHICATION OF LAKES,

Institute for Water and Air Pollution Research, Stockholm (Sweden).

L. Landner.

World Health Organization, Regional Office for Europe, December, 1976. 78 p, 11 tab, 310 ref.

Descriptors: *Eutrophication, *Lakes, *Bibliographies, *Reviews, Documentation, Publications, Ecosystems, Water quality control, Nutrients.

Identifiers: Lake restoration.

This review of the literature of lake eutrophication includes works from 1968 to 1973, with an update to January 1976. For literature prior to 1968 two earlier reviews are cited. In this report, eutrophi-

cation control measures are emphasized, with less attention given to causes of eutrophication. Major sections include aging of lakes, eutrophication symptoms and indices, causes of eutrophication, nutrient sources, eutrophication effects, and lake rehabilitation techniques. A 22-page bibliography follows the extensive literature summary. The subject of eutrophication is at present going through an extremely dynamic research phase, and in many cases the contributions cited have enabled causes and control measures to be identified. As lakes are very complex ecosystems, some kind of simplification has been needed to conceptualize these systems. Vollenweider (1975) has developed a sophisticated set of black box models requiring only inputs and outputs, by which it is possible to predict dangerous phosphorus and nitrogen loadings of lakes relative to the 'mean depth-water fill-in time' ratio. Much fundamental research is still needed for a satisfactory biological understanding of eutrophication. In particular, the complex interactions among the different causes of eutrophication are poorly known. (Lynch-Wisconsin) W78-01020

FATAL DISEASE,

Cornell Univ., Ithaca, NY.

S. A. Carter.

Environment, Vol. 19, No. 3, p 16-20. April 1977, 22 ref.

Descriptors: *Human pathology, *Epidemiology, *Public health, *Human diseases, Water pollution sources, Protozoa, Diseases, Bacteria, Thermal pollution, Soil microorganisms, Sewage, Organic compounds, Hatching.

Identifiers: *Primary amoebic meningoencephalitis (PAME), Amoebae, *Naegleria.

The role of water pollution in the development of amoebae causing a newly-recognized human disease called primary amoebic meningoencephalitis (PAME) is discussed. Seventy-five cases, many in young children, have been reported in the last 20 years. Symptoms include severe headaches, low-level fever, elevated white cell counts in the spinal fluid, and meningeal irritation. Symptoms usually appear within a few days to a week after contact with contaminated water. Amoebae of the genus *Naegleria* have been implicated as a cause of the disease. The presence of certain bacteria is necessary for development of several kinds of soil amoebae. Large amounts of organic matter in soil will favor an extensive development of bacteria, which will be accompanied by an abundance of protozoa such as *Naegleria*. Soil containing amoebae can reach bodies of water from dust raised by plowing, wind, or cars. The cysts (nonpathogenic resting stage of the amoebae) may reach warm, polluted waters through these sources. The high bacterial concentrations in many streams and lakes, due to raised temperatures caused by thermal pollution, can stimulate 'hatching' of amoebae into pathogenic forms, capable of infecting humans. (Spaeth-Wisconsin) W78-01021

ENVIRONMENTAL IMPACT ASSESSMENTS FOR U.S. AND CANADIAN INDUSTRIES,

Jordan (Edward C.), Inc., Portland, ME.

W. H. Parker, III, and B. A. Patric.

Canadian Pulp and Paper Association, Technical Section, Environment Improvement Conference, Montreal, October 6-8, 1976, Preprinted Proceedings (Montreal, P.Q.), p 1-6, 6 tab.

Descriptors: *Environmental effects, *Canada, *United States, *Pulp wastes, Water pollution sources, Pulp and paper industry, Legislation, Economic impact, Social impact, Water quality standards, Foreign countries, Toxicity, Air pollution.

Identifiers: Kraft mills, Bleached pulp mills.

WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

Waste Treatment Processes—Group 5D

(CONSIDERATII SI POSSIBILITATI PRIVIND OPTIMIZAREA CIRCUITELOR APELOR DE FABRICATIE LA C.C.H.-BRAILA),
For primary bibliographic entry see Field 3E.
W78-00985

CHEMICAL AGENTS USED IN THE EFFLUENT TREATMENT PLANT (POMOCNE CHEMICKE PROSTREDKY V CISTIRNE OD-PADNICH VOD),
M. Milichovsky, and P. Vymazal.
Papir a Celuloza, Vol 29, No 10, p 243-244, 1974. 1 fig, 5 ref.

Descriptors: *Filtration, *Pulp wastes, *Waste water treatment, *Water purification, *Sludge treatment, Industrial wastes, Sludge, Aluminum, Sulfates, Separation techniques, Lime.
Identifiers: Percol 140, Polyacrylamide, Polymim SN, Polyethylenimine.

A mechanical treatment plant for the effluent from a board mill is described. The plant consists of two parallel operating clarifiers. The sludge-handling part consists of drum filters for the separation of the fibrous fraction which is reused, and Wagner filters for the fine fraction which is disposed of in a landfill. The treatment process uses a combination of alum and Percol 140 (polyacrylamide) added ahead of the clarifiers. The water is neutralized with CaO. The fine sludge conditioning to improve the separation is done with Polymim SN added in the amount of 30 g/kg of dry sludge. To achieve a good retention of fine particles on the wire, alum is also added to the stock. (Trubacek-IPC)
W78-00987

FLOCCULATING AGENTS DERIVED FROM KRAFT LIGNIN,
British Columbia Research Council, Vancouver.
A. B. McKague.
Journal of Applied Chemistry and Biotechnology, Vol 24, No 10, p 607-615, October, 1974. 4 tab, 12 ref.

Descriptors: *Lignins, *Flocculation, *Pulp wastes, *Color, Ammonium salts, Aluminum, Sulfates, Organic compounds, Colloids.
Identifiers: Indulin AT, 4-propylguaiacol, Mannich reaction.

The Mannich reaction product, a dihydrooxazine, and a quaternary ammonium salt were prepared in high yield from the lignin model compound, 4-propylguaiacol. Extension of the same reactions to the purified kraft lignin, Indulin AT, gave products which flocculated and removed color from bleached kraft mill effluent. Color removal was most efficient with the Indulin AT quaternary ammonium derivative where, in one case, a dose of 250 mg/liter at pH 7.2 removed 95% of the color. The product from the dihydrooxazine preparation had the poorest flocculating characteristics; the Indulin AT Mannich base was intermediate. None of the lignin materials was as efficient as aluminum sulfate in removing color. (Witt-IPC)
W78-00988

ELECTRICITY INDEPENDENCE FOR TWO MUNICIPAL SERVICES.
Gas and Oil Power, Vol. 68, No. 775, p 180-183, Winter, 1972. 6 fig.

Descriptors: *Treatment facilities, *Sewerage, Floods, Cities, Flow rates, Sludge digestion, Pumping plants, Electrical power.
Identifiers: Bristol, England, Sludge gas, Fuel requirements, Sewage pumping.

In the municipal area of Bristol, England, the problem of river pollution due to increased population is being checked by regular improvement and extensions to the sewer system and new sewage pumping and treatment works. The storm water in-

ceptor tunnel, designed to relieve flooding in parts of the city, is used also to convey sewage from the out-lying areas. The main pumping station is designed for an ultimate mean dry weather flow of 2.05 cu m/sec and a maximum flow of 12.25 cu m/sec. Providing base-load electrical power to meet the requirements of the sewage treatment plant and main pumping station are four naturally aspirated dual-fuel engines each coupled to a 494kW, 3.3kV, 500 rev/min alternator of the self-regulating type. With the use of waste heat recovery, an overall thermal utilization of 82 percent is achieved at full load. Investigations to assess the future works' load and pumping load indicate that extensions to the generating station would meet the increasing loads. Additional fuel to meet the increased requirements of the extended powerplant installation will be provided by extensions to the works' sludge digestion tanks and gas recovery plant. On completion, sludge gas yield will be sufficient to meet the fuel requirements of the engines when the alternator sets are providing base-load power for the sewage works and incinerator. The dual-fuel operation of the latest engines employs a hydraulically operated gas inlet valve fed from a high-pressure pump via a camshaft-driven distributor. (Sandoski-FIRL)
W78-00991

INTERCEPTOR INSTALLATION FOR YUBA CITY, CALIFORNIA.
Water and Sewage Works, Vol 120, No 1, p 80-82, January, 1973. 2 fig.

Descriptors: *Waste water treatment, *Treatment facilities, Interceptor sewers, Pipes, Construction, Plastic pipes, California.
Identifiers: Yuba City(Calif), Techite.

A reinforced plastic mortar interceptor for a regional waste water treatment plant is part of a planned, staged development project for upgrading the sewage treatment capability of Yuba City, California. The interceptor, which is 1.8 miles long, is connected at its beginning to the new treatment plant under construction and traverses a depth of from 18 feet to 14 feet. The line contains 2950 feet of 42-inch inner diameter gravity pipe, and 6175 feet of 36-inch inner diameter gravity pipe, 325 feet of 25-inch inner diameter gravity pipe, and 315 feet of 18-inch inner diameter force main pressure rated at 150 feet per head. The Techite reinforced plastic mortar pipe, manufactured by United Technology Center of Riverside, California, was purchased and trucked to the site in 20 foot lengths. (Sandoski-FIRL)
W78-00994

DISSOLVED AIR FLOTATION FOR COMBINED SEWER OVERFLOWS,
Engineering-Science, Inc., Arcadia, CA.
R. L. White, and T. G. Cole.
Public Works, Vol 104, No 2, p 50-54, February, 1973. 2 fig, 2 tab.

Descriptors: *Combined sewers, Waste water treatment, Storm water, Cities, Construction, Effluent, Treatment facilities, Sedimentation, Outfall sewers, California.
Identifiers: San Francisco(California), Dissolved air flotation.

The City and County of San Francisco in its program for upgrading the quality of wet-weather discharges from its combined sewer system financed the development of a comprehensive program for control of wet-weather flow. The program consisted of design construction, operation, and evaluation of demonstration dissolved air flotation facility for overflow treatment. The demonstration facility is located near the principal municipal marina on the northern shoreline of the city. The overall project was divided into three phases extending from 1968 to 1971: (1) preconstruction studies on quantity and quality relationships of combined sewer flows and receiving

waters; (2) design and construction of a dissolved air flotation (DAF) facility; and, (3) postconstruction studies on operation and evaluation of the DAF facility and receiving waters. The automated 24 mgd facility is provided with trash racks, short-term sedimentation for removal of settleable solids, dissolved air flotation for removal of floatable materials, and disinfection by chlorination with the effluent discharged to the Bay through a submerged outfall sewer. Monitoring the evaluation programs conducted during the 1970-1971 wet-weather season resulted in minor modifications and additions to the DAF facility to be constructed in time for the 1972-1973 wet-weather season. (Sandoski-FIRL)
W78-00995

SEWAGE PURIFICATION

Australian Patent 431,067. Issued January 4, 1973. Official Journal of Patents, Trade Marks and Designs, Vol 42, No 49, p 4793, January 4, 1973.

Descriptors: *Sewage treatment, *Sewage, *Activated sludge, Oxygen, Patents, Waste water treatment, Aeration.
Identifiers: Surface aerator.

An installation for the purification of sewage by means of the activated sludge method has been patented. The system comprises an annular, horizontally disposed circuit adapted to receive the sewage to be purified and two communication sections interconnecting said portions. A surface aerator mounted in one of the communication sections so as to be partially submerged in the sewage received is rotated about a vertical axis to add oxygen to the sewage in the circuit. A partition arranged in the circuit near the surface aerator is closed off on one side of the aerator whereby said surface aerator brings the sewage into circulation within the circuit. (Sandoski-FIRL)
W78-00996

DEVELOPMENT OF AN UNCONVENTIONAL APPROACH TO NITRIFICATION-DENITRIFICATION

Texas Tech Univ., Lubbock. Water Resources Center.
E. D. Smith, R. M. Sweazy, M. L. Peebles, R. C. Baskett, and R. H. Ramsey, III.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-274398. Price codes: A08 in paper copy, A01 in microfiche. Final Report WRT-77-2, September 1977, 162 p, 36 fig, 25 tab, 62 ref, 4 append. OWRT A-035-TEX(I). 14-34-0001-6045, 7091, 7092.

Descriptors: Municipal water, Nitrates, Aquifers, Texas, Nitrification, Denitrification, Nitrates, Sewage effluents, *Waste water treatment, Lime. Identifiers: *Texas High Plains, Lime treatment.

In water-short regions such as the Texas High Plains, municipal wastewater is frequently used to combat irrigation water shortages. One problem resulting from this practice is nitrate pollution of underlying aquifers. Nitrate pollution manifests itself primarily in public health problems and eutrophication. Studies were conducted to evaluate the feasibility of using an unconventional system for nitrifying and denitrifying sewage effluent. The research plan was to stop the nitrification process at the nitrite step, at which point denitrification was promoted. Theoretically, in this manner, less oxygen will be used to convert the ammonia than is required in conventional systems, and less supplemental carbon will have to be supplied for denitrification from the nitrite form. The primary nitrification study showed that a large, stable, reproducible population of nitrate-forming bacteria may be cultured and maintained by a daily input of ammonium sulfate feed solution to a complete-mix treatment regime. Good process control (pH) was required to ensure the biological transformation of ammonia-N to nitrite without simultaneous production of nitrate-N. Biological

Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5D—Waste Treatment Processes

nitrification by this system was a reliable process for accumulating relatively high concentrations of nitrite. The preliminary and primary denitrification studies validated the fact that strain 39 of *Achromobacter liquefaciens* was capable of reducing relatively high concentrations of nitrite-N. The draw-and-fill mode of continuous operation in the primary study indicated that this form of non-conventional denitrification was a reliable process for removing nitrates from wastewater. A hypothetical flow diagram for such a retrofit system was outlined, with a design sequence using lime treatment as a first stage. The results of these studies indicate that this type of unconventional nitrification-denitrification system exhibits potential for the development of an economic and effective method of nitrogen control.

W78-01002

RECENT EVOLUTION OF THE DIFFERENT LEVELS OF MARINE POLLUTION OF THE SOFT SUBSTRATE LINKED WITH THE BIG SEWER OF MARSEILLE-CORTIOU. (IN FRENCH)

For primary bibliographic entry see Field 5C.

W78-01015

SAMPLING OF INDUSTRIAL WASTEWATER HELPS MEET DISCHARGE STANDARDS,

Clinton Bogert Associates, Fort Lee, NJ.

For primary bibliographic entry see Field 7B.

W78-01073

TREATMENT SYSTEM IS INNOVATIVE FOR COAL STORAGE FACILITY,

Goodkind and O'Dea, Inc., Clifton, NJ.

M. Kaneletz, and J. J. Hess.

Water and Wastes Engineering, Vol. 14, No. 5, p 28-32, May, 1977, 3 fig, 1 tab.

Descriptors: *Leachate, *Surface runoff, *Coals, *Multi-purpose projects, *Water reuse, Dusts, Industrial water, Clarification, Flocculation, Water storage, Industrial wastes, Waste water treatment. Identifiers: Coal storage, Dust control, Fire protection, Leachate treatment.

The water treatment facility at the Superior, Wisconsin, coal terminal was designed to treat runoff and leachate from the coal storage piles at the 194-acre facility for discharge to the St. Louis Bay. The plant also provides water for dust control and fire protection at the coal handling facility. The State of Wisconsin Division of Natural Resources required that effluents from the facility meet existing water standards for Lake Superior as well as an average monthly suspended solids content of 15 mg/liter. The treatment process chosen for the leachate included flocculation with lime and an anionic polyelectrolyte followed by pH neutralization with sulfuric acid after sedimentation removes solids. Water destined for use in dust suppression and fire protection is passed through a microstrainer to remove all suspended solids 150 microns or larger. The runoff and leachate treatment system, which is activated when the quantity of water exceeds the amount required for plant operation, includes storm water detention and conveyance facilities, a clarifier-flocculator, a chemical feed and storage facility, laboratory facilities, two sludge pumps, and two sludge lagoons. The dust suppression and fire protection system is activated on demand and includes a raw water intake system two microstrainer lift pumps, a microstrainer, a 50,000-gal water storage tank, four split-case high pressure pumps, two 7,500-gal hydro-pneumatic tanks and air compressors, and a surfactant feed system. (Schulz-FIRL)

W78-01074

ENSO-BIOX METHOD — A BIOLOGICAL METHOD FOR PURIFYING KRAFT PULP MILL CONDENSATES,

Enso-Gutzeit Oy, Imatra (Finland).

I. Vettentranta.

Canadian Pulp and Paper Association, Technical Section, Environment Improvement Conference, Montreal, October 6-8, 1976, Preprinted Proceedings (Montreal, P.Q.), p 7-12, 3 fig, 4 tab, 4 ref.

Descriptors: *Pulp wastes, *Waste water treatment, *Biological treatment, Water pollution sources, Water pollution treatment, Wastes, Industrial wastes, Waste treatment, Foreign countries, Filtration, Filters, Bark, Pulp and paper industry, Nutrients, Sulfur bacteria, Sulfur compounds, Effluents, Water pollution control, Softwood, Europe.

Identifiers: Finland, Condensates, Kraft mills.

The Enso-Gutzeit Oy, Research Center in Imatra, Finland, has developed a biological filtering method for removing sulfur compounds from condensates of the kraft pulping process. The first mill-size unit was built at Uimaharju kraft pulp mill. The liquid and gas filters use a filtering medium of softwood bark treated with a nutrient mixture to support growth of the sulfur bacteria. After being purified in the liquid units, the condensates are clean enough to be released into the water system. Because the air which is blown through the liquid units becomes contaminated in the process, it is purified in the gas filter unit before being released into the atmosphere. Mill tests show that over 90% of the malodorous sulfur compounds of evaporator and digester condensates were removed. (Swichtenberg-IPC)

W78-01100

ADJUSTMENTS AND INNOVATION IN A FRENCH PAPER MILL (ADJUSTEMENTS ET INNOVATIONS DANS UNE PAPETERIE FRANÇAISE),

Aussedat-Rey Papeteries de France, Saillat.

J. Rodeaud.

Canadian Pulp and Paper Association, Technical Section, Environment Improvement Conference, Montreal, October 6-8, 1976, Preprinted Proceedings (Montreal, P.Q.), p 13-18, 3 fig, 3 tab, 5 ref.

Descriptors: *Pulp wastes, *Waste water treatment, *Biological treatment, Wastes, Industrial wastes, Waste treatment, Water pollution treatment, Water pollution sources, Foreign countries, Sludge, Incineration, Aerated lagoons, Mixing, Treatment facilities, Europe.

Identifiers: France, Kraft mills, Bleached pulp mills.

Pollution-control facilities at the integrated bleached kraft mill of Aussedat-Rey/Papeteries de France at Saillat, France are described. Emphasis is on the incineration of primary sludge in the lime kiln and on biological effluent treatment in aeration lagoons of the canal type with low level of mixing. (Speckhard-IPC)

W78-01101

ENERGY VS. ENVIRONMENT — FRIENDS OR FOES, EKONO, Helsinki (Finland).

H. Mannisto, E. Sebbas, and E. N. Westerberg, Canadian Pulp and Paper Association, Technical Section, Environment Improvement Conference, Montreal, October 6-8, 1976, Preprinted Proceedings (Montreal, P.Q.), p 27-34, 8 fig, 3 tab, 7 ref.

Descriptors: *Water pollution control, *Energy, *Pulp and paper industry, Steam, Water pollution sources, Wastes, Industrial wastes, Waste treatment, Water pollution treatment, Waste water treatment, Electric power demand, Effluents, Pulp wastes, Pollution abatement. Identifiers: *Kraft mills.

A case study of a single-line bleached kraft mill with a batch digester shows that a reduction in the pollutant load of effluents can be accomplished by

implant controls and external treatment without increasing mill energy consumption. Implant measures to minimize the water pollutant load include: closing the water system of the wet drum barkers, increasing the active alkali charge to the digester, closing the water system for pulp screening and adjusting water usage to an optimum dilution factor, closing the bleach plant water system, stripping the condensates from the digester and evaporator to allow reuse in brown stock washing and causticizing, and collecting and returning spills to process streams. The increase in the process heat consumption due to the in-plant measures is about 850,000 Btu/short ton (sht) of air-dry bleached pulp. The increase in power consumption is estimated to be 15 and 20 kw-hr/sht for in-plant measures and external treatment, respectively. Because of more efficient recovery of the dissolved dry solids, the steam generation in the recovery boiler is increased by about 1,000,000 Btu/sht. The power required for combined in-plant measures and external treatment can be generated as the by-product power. The heat consumption to generate 3.5 kw-hr/sht is about 130,000 Btu/sht, assuming heat consumption for back-pressure e power generation is 3600 Btu/kw-hr. After power generation, the increase in steam generation is thus 870,000 Btu/sht, which corresponds almost exactly to the increase in process heat consumption. (Swichtenberg-IPC)

W78-01103

NEW IN-PLANT TECHNOLOGY TO REDUCE POLLUTION FROM A SODIUM-BASE SULFITE MILL,

MoDoCell A.B., Ornskoldsvik (Sweden).

R. Brannland, R. Gustafsson, and B. Hultman.

Canadian Pulp and Paper Association, Technical Section, Environment Improvement Conference, Montreal, October 6-8, 1976, Preprinted Proceedings (Montreal, P.Q.), p 49-53, 7 fig, 1 tab, 8 ref.

Descriptors: *Pollution abatement, *Pulp wastes, *Bleaching wastes, *Sulfite liquors, Air pollution, Water pollution control, Pulp and paper industry, Water pollution sources, Water quality control, Foreign countries, Wastes, Industrial wastes, Bleaching wastes, Chemical oxygen demand, Biochemical oxygen demand, Chlorides, Waste water treatment, Waste treatment, Europe, Water reuse, Sodium chloride, Industrial water, Chlorides.

Identifiers: *Sulfite pulp mills, Sweden, Chemical recovery, Spent sulfite liquors, Condensates.

In-plant measures taken to reduce air and water pollution at a Swedish sulfite pulp mill are described. A flow diagram is presented of the Stora chemical recovery process used at the sodium-base sulfite pulp mill. Prior to evaporation, before and after the alcohol fermentation plant, the acidic spent sulfite liquor is treated with alkali (viz., sodium bicarbonate, NaOH, or oxidized green liquor) to raise the pH to 4.5-5.0 and 6.5 in the pre-evaporation and the final evaporation processes, respectively. Neutralization of the spent sulfite liquor decreases the transfer of acetic acid to the total condensate by 70%, thus decreasing the 7-day BOD from 25 to 12 kg/ton of pulp. The condensate is reused in the cooking liquor and for final pulp wash time in the bleach plant. Changing the bleaching sequence from CEHD to ECHD allows the extraction effluent to be returned to the recovery furnace via the screen room and unbleached pulp washing plant. Bleach effluent color and COD are significantly reduced compared to the previous CEHD sequence. The BOD reduction is not so impressive, but it is at least equivalent to that leaving a kraft pulp CEHDED bleaching incorporating ion-exchange treatment of the first extraction-stage effluent. Chloride concentration should not be more than 0.8 g NaCl/liter in the cooking acid if chemical recovery is to be effective. A chloride removal system is described involving scrubbing of flue gas containing HCl formed from the reaction of oxygen, sulfur dioxide, and NaCl. (Swichtenberg-IPC)

W78-01104

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WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

Waste Treatment Processes—Group 5D

W78-01104

WASTE HEAT FOR EVAPORATION OF EF- FLUENTS,

Ekono, Helsinki (Finland).

J. Orivuori, E. Sebbas, and E. N. Westerberg.
Canadian Pulp and Paper Association, Technical
Section, Environment Improvement Conference,
Montreal, October 6-8, 1976, Preprinted
Proceedings (Montreal, P.Q.), p 55-60, 6 fig, 5 tab,
5 ref.

Descriptors: *Pulp wastes, *Evaporation,
*Energy, *Waste water treatment, *Heat balance,
Wastes, Industrial wastes, Water pollution treat-
ment, Effluents, Pulp and paper industry, Costs,
Temperature, Industrial water, Water reuse.

Identifiers: *Heat recovery, *Newsprint mills,
*Closed systems.

A newsprint mill using 80% groundwood and 20% chemical pulp furnish examined the feasibility of using waste heat generated in a closed water system for effluent evaporation. Heat balance calculations for the groundwood mill (power consumption 1200 kw-hr/short ton (sht) of air-dry product with 15% loss to the atmosphere and 30% to vapor flash) show that there is a waste heat of 2,300,000 Btu/sht which has to be removed by cooling of the groundwood mill's recycled water. The amount of water recirculating in the groundwood pulp mill is about 13,000 gal/sht. This water volume must be cooled from 158 F (maximum allowable temperature of the groundwood pulp slurry) to 136 F (temperature of the paper machine white water) in order to keep the in- and out-going process heat flows in balance. Since there is no need for hot process water, and the temperature of the waste heat is relatively high, it is possible to utilize the heat for evaporation of the effluent. The reuse water from the groundwater mill is cooled in a heat exchanger and the waste heat is transferred to the effluent evaporator. An evaporation plant using waste heat would consume about 30-40 kw-hr/1000 gal water. Preliminary cost estimates show costs of waste heat evaporation comparable with costs of external treatment methods. (Swichtenberg-IPC)

W78-01105

PROCESS CONCEPTS FOR OXYGEN DELI- GIFICATION,

MoDoCell A.B., Ornskoldsvik (Sweden).

R. Hillstrom, B. Lindqvist, L. Smedman, and A. Jamieson.

Canadian Pulp and Paper Association, Technical
Section, Environment Improvement Conference,
Montreal, October 6-8, 1976, Preprinted
Proceedings (Montreal, P.Q.), p 61-65, 7 fig, 4 tab,
5 ref.

Descriptors: *Water pollution control, *Oxygen,
*Bleaching wastes, Pulp and paper industry,
Foreign countries, Biochemical oxygen demand,
Color, Chlorine, Bleaching wastes, Capital costs,
Pulp wastes, Europe, Effluents, Carbon dioxide.
Identifiers: *Kraft mills, *Delignification,
Sweden, Turpentine, Carbon monoxide.

Based on measurements made on total effluents at MoDoCell AB and Munksjö AB, Sweden, a kraft mill with closed screening, condensate treatment, and OC/DEDED bleaching (compared to CEHDED bleaching) can achieve a 53% reduction in 7-day BOD (from 38 to 18 kg/ton of pulp), a 72% reduction in effluent color (from 250 to 70 kg Pt/ton of pulp), and a 62% reduction in organically bound chlorine (6.5 to 2.5 kg/ton of pulp). A system designed by MoDoCell removes flammable CO and turpentine from the oxygen reactor by catalytic oxidation of these gases to carbon dioxide in a circulating gas stream connected to the oxygen reactor. The exhaust gas is then cooled and recirculated to the oxygen reactor. The carbon dioxide is absorbed in and discharged with the pulp. Temperature control of oxygen delignification

by the same system is also described. A simplified oxygen bleaching system operating at low consistency and with equipment coupled directly to the continuous digester reduces capital costs. (Swichtenberg-IPC)

W78-01106

EFFLUENT QUALITY IMPROVEMENT IN A BLEACHED KRAFT PULP MILL,

MacMillan Bloedel Ltd., Nanaimo (British Columbia).

N. A. Eckstein.

Canadian Pulp and Paper Association, Technical
Section, Environment Improvement Conference,
Montreal, October 6-8, 1976, Preprinted
Proceedings (Montreal, P.Q.), p 67-73, 4 fig, 5 tab.

Descriptors: *Pulp wastes, *Water pollution control,
Wastes, Industrial wastes, Water pollution sources,
Suspended solids, Foaming, Color, Odor,
Filters, Outlets, Pulp and paper industry, Effluents,
Pollution abatement, Waste dilution,
Foreign countries, Canada, Fly ash, Water quality control,
Diffusion, Pipelines.
Identifiers: Spills, Clarifiers, Kraft mills,
Bleached pulp mills.

An effluent quality improvement program begun in 1970 at the Harmac Division of MacMillan Bloedel Ltd., B.C., resulted in substantial reductions in suspended solids, inorganic and organic chemical spillage, and elimination of foam, color, and odor from the surface of the receiving waters. Discharges of suspended solids were reduced in the recausticizing plant by installation of a Dorr-Oliver green dredge filter and a clarifier to handle dust from four slaker vents. Steam-plant, woodroom, and screen-room discharges were similarly lowered by installation of a clarifier to remove solids in fly ash from multiclone gas cleaners, woodroom and screen-room reject streams. Probes for level control were installed in various trenches in the recausticizing area to avoid chemical spillage. A diffuser was placed on the end of a 3200 ft pipeline at a depth of 320 ft in the Northumberland Channel to dilute the effluent and eliminate surface water contamination. (Swichtenberg-IPC)

W78-01107

BIO-TREATMENT OF EFFLUENTS WITH BOD BELOW 100 MG/LITER,

Research Association for the Paper and Board,
Printing and Packaging Industries, Leatherhead
(England).

W. G. Cobbett.

Canadian Pulp and Paper Association, Technical
Section, Environment Improvement Conference,
Montreal, October 6-8, 1976, Preprinted
Proceedings (Montreal, P.Q.), p 87-93, 7 tab.

Descriptors: *Pulp wastes, *Waste water treatment,
*Biological treatment, *Biochemical oxygen demand,
Wastes, Waste treatment, Industrial wastes,
Water pollution treatment, Water pollution sources,
Foreign countries, Percolation, Filters, Activated sludge, Land, Hydrogen ion concentration,
Microorganisms, Phosphorus, Sludge, Fungi, Pulp and paper industry, Europe, Effluents.
Identifiers: England.

Treatment of the weak effluent from two paper mills in the United Kingdom has been successful in pilot bio-treatment plants using the percolating filter or activated sludge systems. The study showed that all units could process double the conventional BOD loading to give a final effluent BOD of less than 10 mg/liter. Operational difficulties encountered with the pilot plants are described. The land requirement for full-scale plants at the mills was assessed. For these weak effluents, the percolating filter systems would occupy less than 3 times the area needed for an equivalent activated sludge plant. Plant performances were studied under various typical con-

ditions of mill operation. Both the systems could overcome the problem of periodic shutdowns and recover quickly after shock loads of strong paper mill chemicals if the application was moderate. Variation in effluent pH influenced the population of microorganisms but had little effect on plant efficiency. The minimum total P content of the effluent for satisfactory biological action in BOD removal was a P:BOD ratio of 0.55:100, which applied to both percolating filters and activated sludge units. The amount of secondary sludge obtained from the bio-treatment plants was less than 10% of the mill primary sludge. Sewage fungus growth, prevalent at one of the participating mills, was reduced to the level commonly found in the receiving stream as a result of bio-treatment. (Swichtenberg-IPC)

W78-01109

LIME TREATMENT OF BLEACHERY EF- FLUENT,

CIP Research Ltd., Hawkesbury (Ontario).

F. M. A. Nicolle, R. Shamash, K. V. Nayak, and J. A. Histed.

Canadian Pulp and Paper Association, Technical
Section, Environment Improvement Conference,
Montreal, October 6-8, 1976, Preprinted
Proceedings (Montreal, P.Q.), p 95-101, 5 fig, 5 tab, 11 ref.

Descriptors: *Bleaching wastes, *Waste water treatment,
*Lime, Wastes, Industrial wastes, Water pollution treatment, Water pollution sources, Pulp wastes, Pulp and paper industry, Effluents, Color, Chemical oxygen demand, Fish, Toxicity, Hydrogen ion concentration, Sludge, Recycling, Dewatering, Alkalinity, Waste treatment.

An improved lime treatment process for bleach plant effluents is described which requires only one clarifier. Some lime is added to the chlorination filtrate (obtained by countercurrent washing in the C/DEHDED sequence) to provide Ca ions prior to the addition of the extraction-stage filtrate. Following a second addition of lime to the combined chlorination and extraction effluents, Ca precipitation permits fast sedimenting of the lime to occur. Over 80% color removal and 40% COD reduction can be achieved. Fish toxicity is also reduced. Pollutant reduction increases with increasing lime addition and proportion of chlorination effluent treated. Sludge recycling adversely affects color and toxicity reduction and decreases the pH. The alkalinity of the final effluent increases with increasing lime addition and proportion of chlorination effluent treated. Sludge recycling is not recommended, since fresh lime requirements of the system are not reduced. Three alternative schemes for the dewatering of clarifier sludge are discussed. (Swichtenberg-IPC)

W78-01110

TREATMENT OF PULP AND PAPER MILL EF- FLUENTS USING PHYSICAL-CHEMICAL TECHNIQUES,

Pulp and Paper Research Inst. of Canada, Pointe
Claire (Quebec).

A. Wong, and S. Prabhas.

Canadian Pulp and Paper Association, Technical
Section, Environment Improvement Conference,
Montreal, October 6-8, 1976, Preprinted
Proceedings (Montreal, P.Q.), p 103-109, 2 fig, 6 tab, 28 ref.

Descriptors: *Pulp wastes, *Waste water treatment,
Wastes, Industrial wastes, Water pollution sources, Water pollution treatment, Biochemical oxygen demand, Toxicity, Color, Carbon, Adsorption, Foam separation, Lime, Centrifugation, Oxidation, Catalysts, Oxygen, Ozone, Operating costs, Pulp and paper industry, Effluents, Waste treatment, Chlorine.
Identifiers: Hydrogen peroxide, Kraft mills.

Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5D—Waste Treatment Processes

Physical-chemical treatment (PCT) can provide effective reduction of toxicity and color from pulp mill effluents. However, BOD reduction remains a limiting factor for full-scale use at the present time. Physical-chemical detoxification processes for bleached kraft mill effluents (BKME) reviewed include the Pulp and Paper Research Institute of Canada carbon treatment process, granular carbon adsorption, foam separation, and the lime treatment process. Physical-chemical detoxification of mechanical pulping and woodrope effluents is briefly discussed. Adsorption onto polymers and ultracentrifugation are discussed as PCT processes for decoloration of BKME. Reuse of treated effluents introduced chlorine buildup as a major problem. Catalytic oxidation of BKME by hydrogen peroxide, oxygen, or ozone to reduce BOD are reviewed. Operating costs are estimated for each PCT process. (Switzerland-IPC) W78-01111

SEPARATION AND REUSE OF WASTE SOLIDS FROM LIQUID EFFLUENTS,
S. J. Hill, and G. A. Griffiths.
British Paper and Board Industry Federation, Technical Section, Waste Utilization Symposium, Manchester, England, January 22-23, 1975 (Preprinted Proceedings), p 159-162.

Descriptors: *Pulp wastes, *Waste water treatment, Wastes, Industrial wastes, Waste treatment, Flotation, Sedimentation, Filtration, Equipment, Filters, Water pollution control, Water pollution sources, Water pollution treatment, Foreign countries, Europe, Pulp and paper industry, Effluents, Water purification.

Identifiers: White water (Paper machines), Savealls, Fiber recovery, Newsprint mills, United Kingdom.

The on-machine system used by Aylesford Paper Mills (United Kingdom) for the recovery of white water solids involves flotation, sedimentation, and filtration principles. In the savealls, air is mixed with white water under pressure. The air is dissolved in the water, and when the pressure is released on entry into the saveall tank, small air bubbles are formed which lift the solids to the surface of the vessel. Solids are removed by a continuous variable-speed scraper mechanism which pushes the recovered solids into a collection vat at the far end of the tank, the clarified water being removed through a perforated pipe at the bottom of the tank. De Noel towers were installed on two newsprint machines in which white water was fed into the top of the tower and the solids settled to the apex of the cone. The clarified water flowed outward and upward to be recovered over the launder at the top of the tower, and the solids which had thickened at the bottom of the tower were fed back into the machines by gravity, using the head of water in the tower. The filtration units have a number of vertical disks covered with a filtering material mounted on a horizontal shaft, and driven by variable-or constant-speed motors. The disks rotate in a vat filled with sweetened white water. Vacuum is applied, and when the mat is first formed, cloudy filtrate is produced. After the disk emerges from the vat, the vacuum is released and the mat removed by a set of sprays. Experiences with off-machine solids/liquid separation in clarifiers are also outlined. (Sykes-IPC) W78-01112

DISPOSAL AND RECYCLING OF REJECTS FROM WASTE PAPER AND CLOSED WATER SYSTEMS,
Escher Wyss G.m.b.H. Ravensburg (West Germany).
For primary bibliographic entry see Field 3E. W78-01114

UTILIZATION OF SOLIDS FROM WASTE WATER TREATMENT PLANTS IN BOARD MANUFACTURE,

Herzberger Papierfabrik, Ludwig Osthushenrich K.G., Herzberg am Harz (West Germany). K. A. Morsch.

British Paper and Board Industry Federation, Technical Section, Waste Utilization Symposium, Manchester, England, January 22-23, 1975 (Preprinted Proceedings), p 78-94. 2 fig, 6 tab.

Descriptors: *Pulp wastes, *Water reuse, *Waste water treatment, Industrial water, Wastes, Industrial wastes, Water pollution sources, Water pollution treatment, Foreign countries, Europe, Sedimentation, Biological treatment, Water purification, Recycling, Waste treatment.

Identifiers: *Board mills, Germany, Waste paper, Paper converting industry.

The Herzberger Papierfabrik, Ludwig Osthushenrich K.G. group (Germany), is comprised of two integrated board-producing/covering mills and one other facility which is only a board-converting operation. Waste paper accounts for more than 75% of the total raw material used on five paper and board machines. Waste water purification procedures are outlined. Following sedimentation, biological purification, and chemical treatment, the thick-stock material from the waste water treatment plant is sent back to the mixed waste paper pulper for one of the board-manufacturing lines, while another uses chemical-mechanical preclarification plus biological treatment. The influence of recycled solids on board quality and production is also considered. (Sykes-IPC) W78-01115

MECHANICAL DEWATERING OF SEDIMENTS FROM ROOFING BOARD FACTORY EFFLUENTS (OPT MEKHANICHESKOGO OSADKOV STOCHNYKH VOD KARTONNO-RUBEROIDNYKH ZAVODOV),
Academy of Municipal Economy, Moscow (USSR), Research of Public Water Supply, Water Purification.
For primary bibliographic entry see Field 5E. W78-01120

TREATMENT PLANT FOR EFFLUENT FROM THE ALBRUCK PAPER MILL,
F. Barlog.
Sulzer Technical Review, No. 4, p 173-176, 1976. 4 fig, 3 tab, 1 ref.

Descriptors: *Pulp wastes, *Waste water treatment, *Treatment facilities, Foreign countries, Europe, Wastes, Industrial wastes, Waste treatment, Water pollution treatment, Water pollution sources, Flocculation, Sludge, Pulp and paper industry, Effluents, Mixing, Circulation, Coagulation, Sedimentation.

Identifiers: Germany.

The effluent treatment plant installed at Papierfabrik Albruck (Germany) is described. The plant employs Sulzer-Opur sludge contact flocculation and operates with external sludge circulation. The system combines the physicochemical treatment stages of mixing, circulation, coagulation, flocculation, sedimentation, and preliminary thickening in one compact apparatus. (Speckhard-IPC) W78-01121

RESULTS OF AN NCASI PILOT PLANT STUDY OF MECHANICAL DEWATERING ALTERNATIVES FOR WASTE ACTIVATED SLUDGE,

National Council of the Paper Industry for Air and Stream Improvement, Inc., Kalamazoo, MI. R. A. Miner, D. W. Marshall, and I. Gelman.

TAPPI Environmental Conference Papers, Chicago, April 25-27, 1977, (Preprinted Proceedings, TAPPI, Atlanta, Ga.), p 11-24. 4 fig, 6 tab, 8 ref.

Descriptors: *Activated sludge, *Sludge treatment, *Dewatering, *Pulp wastes, Wastes, Industrial wastes, Pulp and paper industry, Filtration, Centrifugation, Sludge, Water pollution treatment, Water pollution sources, Waste treatment, Pilot plants, Solid wastes.

Identifiers: Ultrafiltration.

A pilot investigation of biological sludge thickening and dewatering alternatives including pressure filtration, precoat vacuum filtration, filter belt pressing, capillary suction dewatering, gravity filtration, centrifugation, and ultrafiltration, was conducted on waste activated sludge resulting from the treatment of effluent from an integrated bleached kraft-fine paper mill. Based on criterion of attainable cake consistency, three levels of performance are indicated: (1) pressure filtration and precoat vacuum filtration generating the driest cakes, (2) filter belt pressing yielding intermediate cake consistencies, and (3) gravity filtration, centrifugation, and ultrafiltration resulting in relatively low cake consistencies. In general, performance was severely affected by changes in feed sludge consistency, the amount of sludge conditioning, and the sludge's specific resistance to filtration. The type and amount of sludge conditioning required is variable, depending upon the dewatering technique used, and the consistency and nature of the sludge. (Witt-IPC) W78-01123

TOTAL WATER SYSTEM (AT) COSHOCOTON MILL (OF) STONE CONTAINER CORPORATION,
Stone Container Corp., Coshocton, OH.
For primary bibliographic entry see Field 3E. W78-01124

PHYSICAL-CHEMICAL TREATMENT SYSTEM AT FITCHBURG, MASSACHUSETTS,
Camp, Dresser and McKee, Inc., Boston, MA. W. F. Callahan, and A. B. Pincince.
TAPPI Environmental Conference Papers, Chicago, April 25-27, 1977, (Preprinted Proceedings, TAPPI, Atlanta, Ga.), p 33-37. 4 tab, 4 ref.

Descriptors: *Pulp wastes, *Municipal wastes, *Waste water treatment, *Treatment facilities, Wastes, Industrial wastes, Water pollution sources, Water pollution treatment, Activated carbon, Lime, Aeration, Biochemical oxygen demand, Suspended solids, Hydrogen sulfide, Sodium compounds, Massachusetts, Adsorption, Waste treatment.

Identifiers: Aluminum sulfate, Sodium hydroxide, Sodium nitrate.

The city of Fitchburg, Massachusetts, has constructed and placed in operation two advanced waste treatment plants. The East Plant uses a two-stage activated sludge process to treat largely domestic waste water. The West Plant, located 6 miles (9.6 km) upstream of the East Plant, uses a physical-chemical activated carbon process to treat mainly paper mill effluents (plus domestic waste water). The West Plant's performance is examined based on available data. The industrial and municipal waste waters enter the plant via separate sewers. After comminution and metering, the municipal waste water enters separate municipal clarifiers where it is chlorinated (sodium hypochlorite). From the municipal clarifiers, the effluent is mixed with the industrial waste waters and chemicals (lime and alum), and then flows to two flocculation basins and then to two industrial clarifiers. The clarified effluent is pumped through carbon filters and then to a post-aeration basin before discharge to the Nashua River. The treatment facilities were designed for an average daily flow of 15,300,000 gal/day (57,000 cu m/day) with a BOD loading of 9,700 lb/day (4,400 kg/day) and 48,000 lb/day (21,800 kg/day) of suspended solids. Pilot plant studies showed that both NaOH and sodium nitrate successfully controlled hydrogen

WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

Waste Treatment Processes—Group 5D

sulfide generation in the carbon filters. The pilot plant and its operation are described, and the effects of the chemicals on the adsorptive properties of the carbon are considered. (Witt-IPC)
W78-01125

DETOXIFICATION OF BLEACHED KRAFT MILL EFFLUENTS — A MANAGEABLE PROBLEM,

B.C. Research Ltd., Vancouver.

J. C. Mueller, J. M. Leach, and C. C. Walden.

TAPPI Environmental Conference Papers, Chicago, April 25-27, 1977, (Preprinted Proceedings, TAPPI, Atlanta, Ga.), p 77-81. 4 fig, 4 tab, 13 ref.

Descriptors: *Pulp wastes, *Waste water treatment, *Toxicity, *Pollutant identification, Wastes, Industrial wastes, Water pollution sources, Water pollution treatment, Waste treatment, Pulp and paper industry, Effluents, Biological treatment, Aerated lagoons, Activated sludge, Nutrients, Oxygen, Mixing, Hydrogen ion concentration, Carbon, Foam separation, Pollutants.

Identifiers: Kraft mills, Bleached pulp mills, Aluminum sulfate.

The major toxic constituents in bleached kraft mill effluents have been identified. The biodegradabilities of representative toxicants are, in declining order, dehydroabietic acid, pimaric acid, tetrachloroguaiacol (after adaptation of microorganisms), pimarol, monochlorodehydroabietic acid, dichlorodehydroabietic acid, and trichloroguaiacol. The capacity of various biological treatment systems for detoxification of bleached draft mill effluents was examined. Aerated lagoons and extended activated sludge systems performed well, provided that the supplies of nutrients and oxygen, mixing, and pH were controlled adequately. High-rate activated sludge systems detoxified effluent only 50-70% of the time and required protection against toxicity shock to achieve better than 90% detoxification rates. Physicochemical detoxification techniques, such as activated carbon-alum treatment and foam separation, have been developed to pilot plant scale. (Witt-IPC)
W78-01127

START-UP AND OPERATING EXPERIENCE WITH A TWIN WIRE MOVING BELT PRESS FOR PRIMARY SLUDGE,

Glatfelter Co., Spring Grove, PA.

P. M. Keener, and L. R. Metzger.

TAPPI Environmental Conference Papers, Chicago, April 25-27, 1977, (Preprinted Proceedings, TAPPI, Atlanta, Ga.), p 103-107. 1 tab.

Descriptors: *Pulp wastes, *Sludge treatment, *Dewatering, Wastes, Industrial wastes, Waste water treatment, Water pollution sources, Water pollution treatment, Sludge, Pennsylvania, Pulp and paper industry, Operation and maintenance, Waste treatment.

Effluent sludge at P.H. Glatfelter Company (Spring Grove, Pennsylvania) is being dewatered on a Tait-Andritz sludge-dewatering machine. With throughout rates at times exceeding 50 oven-dry tons/day, the solids leaving the machine have been averaging 35% on an oven-dry basis while requiring 2.5 lb of polymer/oven-dry ton of sludge. (Witt-IPC)
W78-01129

WATER QUALITY PROTECTION AT THE (SIMPSON PAPER COMPANY) SHASTA MILL,

Simpson Paper Co., Anderson, CA.

O. A. Narum, and D. J. Moeller.

TAPPI Environmental Conference Papers, Chicago, April 25-27, 1977, (Preprinted Proceedings, TAPPI, Atlanta, Ga.), p 109-116. 3 fig, 4 tab, 5 ref.

Descriptors: *Pulp wastes, *Waste water treatment, *Treatment facilities, Wastes, Industrial wastes, Waste treatment, Water pollution treatment, Water pollution sources, California, Effluents, Pulp and paper industry, Water reuse, Water conservation, Oxidation pond, Sewage treatment, Biochemical oxygen demand, Suspended solids, Irrigation, Operation and maintenance, Design criteria, Water quality control.

Identifiers: Kraft mills.

In January 1974, Simpson Lee Paper Co. (now known as the Simpson Paper Company) decided to enlarge its recently acquired integrated bleached kraft pulp and paper mill near Anderson, California. The company concluded that conventional effluent treatment methods would not assure compliance with the new National Pollution Discharge Elimination System (NPDES) permit issued by a State agency for the expanded operations. Consequently, the company undertook a four-part program, including greater internal reuse of process water, upgrading of existing primary waste treatment facilities, a new low-rate aerated stabilization basin as secondary waste treatment system, and use of the secondary effluent for irrigation of grain crops. Design criteria and operating performance of the secondary treatment system are detailed. Overall 5-day BOD removal is about 94%, with the final effluent well below the NPDES permit requirement. Total suspended solids do not meet permit limits, but compliance has been achieved by using up to 40% of the secondary effluent for irrigation. (Witt-IPC)
W78-01130

COLOR INCREASE OF TREATED KRAFT MILL EFFLUENTS,

Saint Regis Paper Co., Pensacola, FL.

E. W. Lang, and R. L. Miller.

TAPPI Environmental Conference Papers, Chicago, April 25-27, 1977, (Preprinted Proceedings, TAPPI, Atlanta, Ga.), p 117-124. 3 fig, 3 tab, 9 ref.

Descriptors: *Pulp wastes, *Waste water treatment, *Color, Wastes, Industrial wastes, Water pollution sources, Water pollution treatment, Lime, Carbon, Ozone, Adsorption, Effluents, Pulp and paper industry, Waste treatment, Water properties.

Identifiers: Aluminum sulfate, Kraft mills.

The 1983 Environmental Protection Agency guidelines for discharge of color in effluents from kraft pulp and paper mills require major reductions of color loading. Color reduction processes that have been evaluated in pilot and full-scale plants have been shown to achieve color reductions of primary effluents needed to meet the 1983 guidelines. However, color reversions after color removal and before final discharge of the effluent have often been sufficiently great to exceed the guideline level. Results are reported on studies of color increases of bleached and unbleached kraft mill effluents after treatment with lime, alum, carbon, and ozone. Increases of color after lime treatment are generally sufficiently great to limit its use ahead of secondary treatment. Alum treatment results in smaller increases of color. Color increases were also noted for effluent decolorized by ozone, carbon adsorption, and for untreated effluents. Possible causes for the observed color increases and some of the characteristics of the color bodies are discussed. (Witt-IPC)
W78-01131

LEATHER TANNERY WASTE MANAGEMENT THROUGH PROCESS CHANGE, REUSE AND PRETREATMENT,

Pfister and Vogel Tanning Co., Milwaukee, WI.

J. M. Constantin, and G. B. Stockman.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-264 204, Price codes: A09 in paper copy, A01 in microfiche. EPA-600/2-77-034. January 1977. 181 p, 33 fig, 52 tab, 68 ref.

Descriptors: *Tannery wastes, *Chromium, *Sulfides, *Flocculation, *Chemical precipitation, Water reuse, Separation techniques, Oily water, Industrial wastes.

Identifiers: Chrome recovery, Tanning processes.

Process modifications and waste water reuse and treatment methods to reduce the total waste load discharged from a large side leather tannery were investigated at the Pfister and Vogel Tanning Company in Milwaukee, Wisconsin. Waste water characteristics for the 1.4 mgd produced daily in the processing of 4,350 cattlehides are presented. Laboratory and pilot-scale investigations were used to design a system for the recovery and reuse of chromium-based tanning agents. The system is based on the chemical precipitation of chromium hydroxide with hydrated lime, caustic soda, aqueous ammonia, or soda ash. An anionic polyelectrolyte such as Nalcolyte 667 is then used for flocculation, and gravity settling of the lime-precipitated, flocculated chromium hydroxide was suggested as highly successful. A "straight-through" hair-burn process in which soaking, unhairing, bathing, pickling, and tanning is accomplished in a single unit replaced the conventional hair-save method, thereby reducing the beamhouse-tanery effluent by 50% and eliminating several hide handling steps. The pH decreased from 11.0 to 9.8 and the suspended solid content in the effluent was reduced by 31% with the 50% reduction in lime usage. The increase in sharpeners for hair pulping reduced sulfide loadings by 71%. Substantial reductions in total Kjeldahl nitrogen, volatile suspended solids, and total volatile solids loadings were also observed. Manganese sulfate-catalyzed air oxidation was demonstrated as the most economical means of oxidation of sulfides in unhairing wastes. (Schulz-FIRL)
W78-01136

CATALYTIC WASTE TREATMENT SYSTEMS FOR GREAT LAKE ORE CARRIERS,

Thiokol Corp., Brigham City, UT.

S. E. Moore, R. W. Coleman, and P. E. Lakomski. Available from the National Technical Information Service, Springfield, VA 22161 as PB-260 362, Price codes: A04 in paper copy, A01 in microfiche. EPA-600/2-76-147. September 1976. 63 p, 14 fig, 14 tab, 1 append.

Descriptors: *Incineration, *Chlorination, *Ships, *Separation techniques, *Domestic wastes, Centrifugation, Industrial wastes, Sewage treatment, Sludge disposal.

A program was conducted to develop and demonstrate physical-chemical waste treatment systems for sanitary, galley, shower, and wash water waste streams aboard an operating ore carrier on the Great Lakes. For treatment purposes sanitary and galley wastes were separated from shower and wash water wastes. The aft waste treatment system included a prescreening device to remove coarse solids, a centrifuge for suspended solids, a catalyst to accelerate the reaction between the oxidizing agent and the organic compounds in the waste stream, and a sludge incinerator and sludge feed system. For shower and wash water treatment, water was sterilized with chlorine manufactured on-site by electrolytic cells which convert salt to hypochlorous acid. The waste water treatment systems were subjected to shore and shipboard test programs. The testing programs indicated the need for pretreatment or separation of galley waste from the sanitary waste treatment system, and demonstrated the feasibility of incineration as a means of shipboard sludge disposal. The addition of grease traps to systems treating combined galley/sanitary wastes was recommended. (Schulz-FIRL)
W78-01157

FEASIBILITY OF ELK CREEK ACID MINE DRAINAGE ABATEMENT PROJECT,

Skelly and Loy, Harrisburg, PA.

L. D. Loy, Jr., and J. W. Gunnell.

Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5D—Waste Treatment Processes

Available from the National Technical Information Service, Springfield, VA 22161 as PB-259 329, Price codes: A05 in paper copy, A01 in microfiche. EPA-600/2-76-128. September 1976. 84 p, 33 fig, 6 ref, 1 append.

Descriptors: *Mine drainage, *Neutralization, *Mine acids, *Spoil banks, *Acid mine water, Groundwater movement, Acid streams, Acid-base equilibrium, Trenches, Pollution abatement, Industrial wastes.

Identifiers: Elk Creek(WV).

The Elk Creek watershed in West Virginia was the site of a feasibility study to examine three acid mine drainage abatement techniques, including alkaline regarding, slurry trenching, and mine roof collapse. Physiographic, geologic, mining, and climatologic descriptions are provided for five individual locations used to test the techniques. Alkaline regarding involves neutralization of deep mine discharges with alkaline overburden. In slurry trenching a narrow trench is excavated in unconsolidated material with the vertical sides maintained by a very viscous water clay slurry. Mine roof collapse serves to retard water flow in the mines and neutralizes acidic mine waters in areas with alkaline overburden. The study indicated that all three techniques were viable in the Elk Creek watershed and that at four of the five study sites pollutant loadings with an average acid loading of 1290 kg/day were sufficient to warrant pollution abatement. The alkalinity of strip mine spoil was measured as sufficient for neutralization. (Schulz-FIRL)

W78-01159

NAVAL STORES WASTEWATER PURIFICATION AND REUSE BY ACTIVATED CARBON TREATMENT,

Hercules Inc., Hattiesburg, MS.

F. H. Gardner, Jr., and A. R. Williamson.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-261 168, Price codes: A03 in paper copy, A01 in microfiche. EPA-600/2-76-227. October 1976. 43 p, 7 fig, 5 tab, 5 ref, 2 append.

Descriptors: *Activated carbon, *Adsorption, *Resins, *Organic wastes, *Chemical wastes, Incineration, Chemical oxygen demand, Costs, Treatment facilities, Pilot plants, Water reuse, Industrial waste.

Identifiers: Turpentine, Terpenes, Multiple-hearth incinerators.

The Hercules, Inc., naval stores operation in Hattiesburg, Mississippi, produces a wide variety of industrial products from gum rosin, turpentine, and terpene oils. At the plant, three sewer systems collect waste water and sanitary waste, kept separate from process wastes, for discharge to a municipal sewer system. Cooling waters bypass the waste water treatment system while process wastes, including process area surface drainage, are retained for 5-6 hrs for equalization and primary clarification in a dissolved air flotation unit. An activated carbon adsorption system was evaluated in laboratory and pilot-scale investigations as a means of secondary treatment to remove organics from the primary treated effluent. The treatment configuration chosen included an upflow, packed-bed adsorption tower design with on-site regeneration of the spent carbon in a multiple-hearth furnace. The adsorption system proved capable of removing an average of 79% of the dissolved organics as TOC or COD from influent waste water. Capital costs for the system were \$1,422,000 and operating costs during the evaluation period were \$30,186 per month, or \$0.31/1000 gal. (Schulz-FIRL)

W78-01160

REVERSE OSMOSIS FIELD TEST: TREATMENT OF WATTS NICKEL RINSE WATERS,

Abcor, Inc., Wilmington, MA.

K. J. McNulty, R. L. Goldsmith, and A. Z. Gollan.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-266 919, Price codes: A03 in paper copy, A01 in microfiche. EPA-600/2-77-039. February 1977. 39 p, 6 fig, 6 tab, 11 ref.

Descriptors: *Nickel, *Metals, *Membrane processes, *Reverse osmosis, *Water reuse, Filtration, Pilot plants, Salts, Industrial water, Industrial wastes.

Identifiers: Plating wastes.

The New England Plating Company in Worcester, Massachusetts, was the site of a field test to evaluate the use of a reverse osmosis membrane in hollow fiber configuration for the closed-loop treatment of rinse water from a Watts-type nickel bath. The productivity, or the rate at which permeate is produced with a given system under certain conditions, and the rejection of dissolved species by the membrane were examined to assess the performance of the reverse osmosis system. A schematic diagram of the field test system is presented. Operating conditions for the module were set at a pressure of 28.6 bars, an initial feed flow of 4 gpm, variable conversion and feed concentration, and a temperature of 8-33 C. Rejections observed for nickel, total solids, and conductivity were generally very good, although boric acid was poorly rejected by the membrane because of its ionized form. Rejection for NaCl was 88.5-93.5%. A breakdown of operating costs is presented, with the total annual operating cost projected at \$4,172. (Schulz-FIRL)

W78-01161

DIALYSIS FOR CONCENTRATION AND REMOVAL OF INDUSTRIAL WASTES,

Gulf South Research Inst., New Orleans, LA.

J. K. Smith, S. V. Desai, R. E. C. Weaver, and E. Klein.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-265 572, Price codes: A05 in paper copy, A01 in microfiche. EPA-600/2-76-223. October 1976. 87 p, 19 fig, 13 tab, 18 ref, 4 append.

Descriptors: *Dialysis, *Membrane processes, *Separation techniques, *Solvents, *Filtration, Phenols, Organic wastes, Aluminum, Copper, Lead, Chelation, Pilot plants, Chemical wastes, Industrial wastes.

Dialysis was evaluated as an advanced waste water treatment process for the removal of selected organics and metallic ions from industrial wastes. The study focused on 10 solutes which are potential pollutants of the lower Mississippi River water in the New Orleans-Baton Rouge area: organic acids or bases such as aniline, phenol, and ethanolaniline; toxic cations such as Al(++)+, Cu(++)+, and Pb(++)+; and volatile refractory organics such as nitrobenzene, chloroform, ethylene dichloride, and nitrotoluene. Special techniques to enhance conventional dialysis were investigated, including acid and base conjugation for aniline and phenol; the use of a complexing agent such as bis(2 ethyhexyl) hydrogen phosphate for Al, Cu, and Pb ions; and pervaporation or the removal of a volatile permeant as a vapor on the downstream side of a semipermeable membrane. The rotary batch dialyzer, pervaporation test cell, and membrane used in the study are described. The dialysis system was tested in pilot-scale studies with a Kraton 1101 membrane and a waste stream obtained from an ethylene dichloride manufacturer. (Schulz-FIRL)

W78-01162

WASTE-WATER TREATMENT: ECOLOGICAL, TECHNOLOGICAL AND ECONOMIC ASPECTS (IN GERMAN),

H. A. Weber, and T. Mann.

Naturwissenschaften 64(2): 82-86. 1977 (English summary).

Descriptors: *Water purification, Domestic wastes, Industrial wastes, Waste water treatment, West Germany, Costs, Treatment facilities.

To conserve water and water reserves, waste water must be purified before being discharged. Due to differences in the composition of household and industrial waste, additional physical and chemical purification processes may be required besides the normal biological purification. Variations in legislation in different countries, the high cost of the necessary technical plant expenditures and continually increasing operating costs make the building and operating of wastewater treatment plants extremely problematic. Copyright 1977 Biological Abstracts, Inc.

W78-01163

FOAM FLOTATION TREATMENT OF HEAVY METALS AND FLUORIDE-BEARING INDUSTRIAL WASTEWATERS,

Vanderbilt Univ., Nashville, TN.

D. J. Wilson.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-267 549, Price codes: A05 in paper copy, A01 in microfiche. EPA-600/2-77-072. April 1977. 88 p, 16 fig, 15 tab, 91 ref, 2 append.

Descriptors: *Froth flotation, *Flotation, *Separation techniques, *Heavy metals, *Fluorine, Foam fractionation, Foam separation, Surfactants, Chemical precipitation, Metals, Industrial wastes.

Laboratory studies were used to evaluate floc foam flotation techniques for the reduction of lead, cadmium, mercury, copper, zinc, arsenic, and fluoride in dilute industrial waste waters. A literature review on ion foam fractionation, colloid flotation, and precipitate flotation is presented. Batch laboratory studies examined foam separation for removal of lead, copper, mercury, cadmium, arsenic, and fluoride with sodium lauryl sulfate (SLS) as the anionic surface-active agent and hexadecyltrimethylammonium bromide (HTA) as the cationic surfactant. Adsorbing colloid flotation was studied with Al(OH)3 and Fe(OH)3. The studies concluded that Cu, Pb, and Cd could be readily removed with Fe(OH)3 and SLS; zinc and fluoride with Al(OH)3 and SLS; cadmium with CuS, HTA, and FeS; and mercury with CuS and HTA. The effects of dissolved salt concentrations, temperature, floc electric charge, surfactant concentration, and influent floc concentration on foam separation efficiency were calculated according to a Guoy-Chapman model. (Schulz-FIRL)

W78-01164

INNOVATIVE RINSE-AND-RECOVERY SYSTEM FOR METAL FINISHING PROCESSES,

Industrial Filter and Pump Mfg., Cicero, IL.

W. C. Trnka, and C. J. Novotny.

EPA-600/2-77-099. May 1977. 31 p, 5 fig, 7 tab.

Descriptors: *Water reuse, *Recycling, *Chromium, *Metals, *Equipment, Water utilization, Separation techniques, Ion exchange, Solvent extractions, Anion exchange, Industrial wastes, Waste water treatment.

Identifiers: Chrome recovery, Plating wastes, Metal finishing wastes.

The effectiveness of a solvent rinse which is applicable to metal finishing was investigated with a car bumper plating operation. Use of the rinse-and-recovery system is advantageous in the plating industry since it is a closed system and does not result in the discharge of toxic pollutants to the sewer system. Design and construction data for the unit are presented. The unit includes a vapor adsorber, a plating bath, a rinse tank, separation tank, anion column, chiller, Genesolv-D, and a control cabinet. Vapor recovery is accomplished

WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

Waste Treatment Processes—Group 5D

with adsorption and desorption. The system replaces the conventional multi-stage aqueous rinsing system with a two-stage solvent spray rinse followed by a single-stage aqueous immersion rinse. Perchloroethylene was used as the main solvent flush or the immiscible organic displacing fluid to wash off the dragged-out chromic acid. Pilot studies with the system resulted in a final rinse chromium concentration of about 2 ppm after 80 hr of operation. (Schulz-FIRL)
W78-01165

AMMONIUM-CARBONATE LEACHING OF METAL VALUES FROM WATER-TREATMENT SLUDGES,

Battelle Columbus Lab., OH.
J. B. Hallowell, E. S. Bartlett, and R. H. Cherry, Jr.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-271 014, Price codes: A04 in paper copy, A01 in microfiche. EPA-600/2-77-105. June 1977. 67 p, 1 fig, 7 tab, 2 append.

Descriptors: *Metals, *Copper, *Nickel, *Chromium, *Sludge treatment, Ammonium compounds, Heavy metals, Chemical reactions, Leaching, Electrolysis, Chemical precipitation, Industrial wastes, Sludge disposal, Costs.

Identifiers: Metals recovery, Metal-finishing wastes, Ammonium carbonate.

Experiments were conducted to demonstrate that at least 90% of the copper and nickel in metal-finishing sludges could be removed by leaching with ammonium carbonate. Metal-finishing sludges used in the experiments were obtained from the sludge storage lagoon at the Ametek U.S. Gauge Division plant in Sellersville, Pennsylvania. Treatment of the sludges included electrodeposition of the metallic copper and nickel from the ammoniacal leachant and recovery of chromium from the depleted sludge by a carbonate roast followed by water leaching. Four forms of the Ametek sludge were used in the various leaching experiments, including raw sludge with 20% solids; dried sludge which had been comminuted and blended; dried, ball-milled sludge; and dried sludge which had been washed with water to remove 10% of its weight, followed by filtering, redrying, and grinding. Leaching studies examined the effects of sludge pretreatment, leachant type, temperature, leaching time, aeration and CO₂ sparging, liquor-enrichment, and oxides and hydroxides. Metal recovery was examined with electrolysis, cementation, and precipitation with sodium aluminate. Studies indicated that raw sludge was best leached without pretreatment, with the preferred leachant being ammonium carbonate. The optimum leaching temperature was 50C. Two-stage leaching at 2.3 hr per stage is recommended to reduce the inhibition of nickel removal from copper-rich sludges. Capital costs for a metals recovery plant which processes 100 tons/day of raw sludge to remove copper, nickel, and anhydrous chromic acid were estimated at \$3.5 million. (Schulz-FIRL)
W78-01166

ELIMINATION OF POLLUTION FROM COTTAGE CHEESE WHEY BY DRYING AND UTILIZATION,

Dairy Research and Development Corp., Peekskill, NY.
S. Boxer.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-266 265, Price codes: A04 in paper copy, A01 in microfiche. September 1976. 72 p, 7 fig, 6 tab, 23 ref, 3 append. Technical Report EPA-600/2-76-254.

Descriptors: *Dairies, *Milk, *Feeds, *Recycling, *Drying, *Costs, Food chain, Industrial wastes, Equipment, Nutrient removal, Waste disposal. Identifiers: Cheese whey, Spray drying.

A spray drying process was evaluated for the processing of the more than 1 million lbs of cottage cheese or acid whey produced in the United States annually. A cottage cheese plant of the Dairy Cooperative in Vernon, New York, was the site of a study by the Dairy Research and Development Corporation. The study used a modification of a De Laval Separator Company milk dryer to develop a process for drying acid whey to a non-hygroscopic food grade powder. The process involves evaporation of the raw whey, crystallization, spray drying, and packaging of the dry powder. Problems encountered in the pilot study were related to variations in total solids, lactose crystal uniformity, viscosity, and foaming tendency from one batch of raw whey to the next. Capital costs for a plant designed to dry 500,000 lbs of raw whey daily were projected at approximately \$3 million, with annual operating costs estimated at \$450,000 based on a production of 9 million lbs of whey. The dried end-product of the process has potential uses in the cattle feed, bread, baking, and other food-related industries. (Schulz-FIRL)
W78-01167

STATE OF THE ART: WASTEWATER MANAGEMENT IN THE BEVERAGE INDUSTRY,

Industrial Environmental Research Lab., Cincinnati, Corvallis, OR. Food and Wood Products Branch.
M. E. Joyce, J. F. Scaief, M. W. Cochrane, and K. A. Dostal.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-267 548, Price codes: A07 in paper copy, A01 in microfiche. EPA-600/2-77-048. February 1977. 123 p, 20 fig, 52 tab, 80 ref.

Descriptors: *Food processing industry, *Feeds, *Industrial wastes, *Costs, *Recycling, Water pollution sources, Reviews.

Identifiers: Beverage industry, Malt, Wineries, Distilleries.

A review of the quantity and quality of waste produced by various types of beverage industries and of the waste water management practices used by these industries is presented. Categories of beverage industries which are discussed include malt liquor, malt, wine and brandy, distilled liquors except brandy, canned and bottled soft drinks, and flavorings and extracts. The review concluded that waste water treatment practices in the malt liquor industry were generally different for small and large industries, with small industries less likely to recover and recycle by-products. The majority of the breweries surveyed discharged wastes to the local sewer system instead of maintaining on-site treatment facilities. When by-products are recovered, they are largely used for the production of livestock and poultry feed. Waste water treatment processes used in the wine industry are described as being dependent on the geographic location of the plant and whether or not the winery operates a still. (Schulz-FIRL)
W78-01168

STATE-OF-THE-ART: SWINE WASTE PRODUCTION AND PRETREATMENT PROCESSES,

North Carolina State Univ. at Raleigh. Dept. of Biological and Agricultural Engineering.
M. R. Overcash, and F. J. Humenik.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-267 995, Price code: A09 in paper copy, A01 in microfiche. EPA-600/2-76-290. December 1976. 185 p, 24 fig, 53 tab, 14 ref, 1 append.

Descriptors: *Hogs, *Feed lots, *Livestock, *Farm lagoons, *Oxidation lagoons, Anaerobic digestion, Recycling, Sewage treatment, Separation techniques, Industrial wastes, Reviews.

A review of waste sources and pretreatment processes in the swine processes in the swine processing industry was presented as an overall evaluation of various experimental and demonstration data. Various aspects of swine waste management and swine production are discussed, including housing types, the magnitude and distribution of swine, and population characteristics. Properties of swine waste and production unit waste load are presented for wastes from drylot and pasture production units and for concrete slab and slotted floor-pit wastes. Factors evaluated include type and size of animal, waste volume, solids content, nitrogen, cations, anions, bacteria, BOD, TOC, COD, and miscellaneous parameters. Various pretreatment processes are discussed with respect to altering the land-limiting constituents (LLC) of swine waste, treatment for partial reuse, and complete recycling or reuse of swine wastes. Treatment processes for altering the LLC include anaerobic lagoons, mechanically aerated lagoons, naturally facultative lagoons, rainfall runoff retention ponds, oxidation ditches, and overland flow. Treatment processes for partial reuse include high-rate anaerobic digestion with methane production, solids separation, pyrolysis, and refeeding processes. (Schulz-FIRL)
W78-01169

EXTRACTION OF CHEMICAL POLLUTANTS FROM INDUSTRIAL WASTEWATERS WITH VOLATILE SOLVENTS,

California Univ., Berkeley. Dept. of Chemical Engineering.

J. P. Earhart, K. W. Won, C. J. King, and J. M. Prausnitz.
EPA-600/2-76-220. December 1976. 530 p, 62 fig, 85 tab, 120 ref, 10 append.

Descriptors: *Solvent extractions, *Separation techniques, *Solvents, *Solutes, *Oil wastes, Phenols, Chemical wastes, Solubility, Pilot plants, Distillation, Recycling, Industrial wastes, Waste water treatment, Equipment.

Identifiers: Styrene, Oxychlorination.

Solvent extraction may be a feasible method for treatment of waste water from petroleum refining on petrochemicals manufacture for which process chemicals are expensive, wastes are difficult to treat biologically, or toxic substances present in the waste stream require special handling. General background information presented includes categories of waste water treatment processes, general considerations in solvent extraction, recovery of phenolic compounds, and types of extraction devices. Steam stripping, volatile solvent extraction, and dual solvent extraction processes are described and compared. A pilot-scale study on the use of solvent extraction to treat organic wastes used wastes from tube oil refining, cresylic acid recovery, ethylene quench water, oxychlorination, phenol-formaldehyde resin manufacture, hydrofiner condensate, and styrene manufacture. Analytical methods, equilibrium determinations, the spray column extractor, the rotating biological contactor, solvent regeneration apparatus, and chemicals used in the experiments are described. Methods of data reduction, dispersed phase choice, volatile solvent choice, solute interactions, loaded solvent regeneration, and overall process feasibility are discussed. Results of experiments with a rotating disc contactor (RDC) and industrial wastes are presented. Study results recommended dual-solvent extraction with n-butyl acetate and isobutylene for phenol, cresols, COD, and phenol-formaldehyde manufacturing wastes. (Schulz-FIRL)
W78-01171

METAL REMOVAL AND CYANIDE DESTRUCTION IN PLATING WASTEWATERS USING PARTICLE BED ELECTRODES,

Rockwell International Corp., Canoga Park, CA.
W. Chen, H. L. Recht, and G. P. Hajela.
EPA-600/2-76-296. December 1976. 59 p, 17 fig, 13 tab, 2 ref.

Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5D—Waste Treatment Processes

Descriptors: *Metals, *Heavy metals, *Electrolysis, *Separation techniques, *Water reuse, Electrodes, Pilot plants, Industrial wastes, Nitrogen compounds, Electrolytes, Waste water treatment, Cadmium, Zinc, Salts, Equipment. Identifiers: Cyanide.

The Atomics International (AI) metal-cyanide removal process which uses particle-bed electrodes to remove heavy metals and cyanide from plating rinse waters was evaluated in pilot-scale studies. The process uses an electrolytic cell with a tin particle-bed cathode, a graphite particle-bed anode, and a cellophane separator in which relatively low voltage DC is used to remove contaminants from metals processing waste water. Various studies were conducted to develop the cell design and examine the effects of current, pH, water conductivity, flow rate, and electrode collector spacing on process performance. Studies indicated that metal and cyanide removals by the process were enhanced by higher current, pH, water conductivity, and flow rate and by the addition of a small amount of salt as a supporting electrolyte. Cyanide removals in the pilot-scale testing program ranged from 49-84% and cadmium removals from 66-98%. In on-site tests with filtered cadmium plating-line rinse water, metal removals were 73-95% with NaCl as the supporting electrolyte and 27-58% with Na₂SO₄, while cyanide removals were 79-94% and 44-67%, respectively. With zinc plating-line rinse water, metal removals averaged 75% for NaCl and 81% for Na₂SO₄ while cyanide removals were 78% and 55%, respectively. Cost estimates for the process based on the pilot-plant unit design were projected at \$2.11/1000 gal for a 5-gpm recycle system. (Schulz-FIRL)

W78-01173

FOLLOW-UP INVESTIGATION ON CYANIDE COMPLEX DETECTED FROM PULP SLUDGE (SEISI SURAGI KARA KENSHUTSU SARETA SHIAN KAGOBUTSU NI TSUITE NO TSUSEKI CHOSA), Shizuoka Prefectural Inst. of Public Health (Japan).
For primary bibliographic entry see Field 5B.
W78-01174

EFFECTIVE TEXTILE INDUSTRY EFFLUENT TREATMENT.
International Dyer and Textile Printer, Vol 157, No 4, p 184, February, 1977.

Descriptors: *Oxidation lagoons, *Activated sludge, *Settling basins, *Textiles, *Aeration, Biochemical oxygen demand, Suspended solids, Oxygenation, Industrial wastes, Municipal wastes, Waste water treatment.

Dyeing processes in the textile industry often result in surges of highly toxic waste which can upset conventional waste water treatment systems. The Whitehead and Poole oxidation ditch system is based on the completely mixed, rapid dispersion principle and is designed to accommodate a high sludge/organic load ratio. The rapid dispersion results in rapid transfer of oxygen throughout the tank. The manufacturers report that the Whitehead and Poole oxidation ditch system can produce an effluent which meets the British Royal Commission standards of 20 mg BOD/liter and 30 mg suspended solids/liter. A compact aeration system which operates on the same principles as the oxidation ditch but is contained within a vertical structure of steel or reinforced concrete is also available. (Schulz-FIRL)

W78-01175

SULPHATE REMOVAL FROM CARBONISING AND DYEING WASTE WATERS.
International Dyer and Textile Printer, Vol 157, No 4, p 173, February, 1977.

Descriptors: *Textiles, *Sulfates, *Chemical precipitation, *Lime, *Aluminum, *Sulfur compounds, Chemical reactions, Dyes, Physicochemical properties, Sewerage, Separation techniques, Industrial wastes, Chemical wastes, Waste water treatment.

Identifiers: Carbonizing wastes, Dyeing wastes.

Sulfate ions found in dyeing and carbonizing effluents produced in the wool textile industry can result in the destruction of concrete sewer pipes and the development of anaerobic conditions and hydrogen sulfide. Carbonization, used to break down vegetable matter in highly contaminated wools, typically produces a mixed liquor with a sulfate concentration of approximately 900 mg/liter. Precipitation of the sulfate with lime is limited to concentrations above 1300 mg/liter because of the solubility of calcium sulfate. Precipitation at a pH above 9.5 has been investigated for a mixture of lime and an aluminum salt such as aluminum chlorohydrate or aluminum chloride. Research has indicated that the effluent quality can be controlled by the aluminum and calcium dosages according to the relationship of one cation of aluminum, five cations of calcium, and one anion of sulfate forming an insoluble complex. Since treatment costs may be high, the method is recommended for strong, low-volume effluents. (Schulz-FIRL)

W78-01176

MODERN METHODS OF EFFLUENT TREATMENT,

H. Sandmann.

Brown Bovery Review, Vol. 64, No. 3, p 174-179, March, 1977. 6 fig, 1 tab, 11 ref.

Descriptors: *Effluents, *Chemical precipitation, *Flocculation, *Activated carbon, *Textiles, Industrial wastes, Municipal wastes, Ozone, Ion exchange, Analytical techniques, Waste water treatment.

Various methods of waste water treatment are discussed, including chemical processes, precipitation and flocculation, ozone treatment, adsorption on activated carbon, neutralization, and ion exchange. The use of a combination of processes is described for the treatment of effluents which contain a variety of contaminants. Case studies are presented for the treatment of mixed domestic and industrial effluents and for the treatment of effluents produced by the textile industry. A systems analysis diagram to determine the most effective process combination based on the toxicity, BOD, COD, pH, and C:N:P ratio of the waste water is presented. Effluents at the textile plant were separated for treatment purposes into those which contained heavy dye concentrations and those which were rinse waters and weakly loaded with contaminants. Schematic diagrams of treatment of the two process streams are presented. (Schulz-FIRL)

W78-01177

CAPITAL COST-SAVING SERVICE FOR TEXTILE EFFLUENT TREATMENT.

International Dyer and Textile Printer, Vol. 157, No. 10, p 172-173, February, 1977.

Descriptors: *Adsorption, *Activated carbon, *Dyes, *Color, *Textiles, Treatment facilities, Organic wastes, Filtration, Effluents, Water analyses, Industrial wastes, Waste water treatment.

Identifiers: Carno(Wales), Textile manufacturing wastes.

Chemviron Ltd. of Kingston-on-Thames, Surrey, England, has devised the Chemviron Adsorption Service for the removal of organic pollutants and color from effluents produced by a wide variety of industries, including textiles, pharmaceuticals, detergents, oil refineries, and explosives. The unit has been used by the Laura Ashley textile factory

in Carno, Wales, to remove color and organic contaminants from as much as 100,000 gal of effluent per day. The system was implemented in response to a critical water shortage during a recent drought in England. A mobile tanker filled with activated carbon was installed as an interim treatment method to treat dyehouse effluent until the adsorption module was in full operation. The module designed for Laura Ashley included a motor control center comprised of two sand filters, two adsorbers, and a transfer unit for activated carbon replacement. Pressure filters remove solids from the textile factory effluent before it passes through the beds of granular activated carbon. Analyses of effluents and delivery and replacement of activated carbon are included in the Chemviron Adsorption service along with routine maintenance and technical advice. Chemviron maintains its own activated carbon regeneration facilities in Feluy, Belgium. (Schulz-FIRL)

W78-01178

SOME THOUGHTS ON WATER CONSERVATION AND RE-USE OF PROCESS LIQUORS.

International Dyer and Textile Printer, Vol. 157, No. 10, p 170-171, February, 1977. 8 ref.

Descriptors: *Dyes, *Textiles, *Water reuse, *Water utilization, *Membrane processes, Filtration, Color, Organic wastes, Industrial water, Reverse osmosis, Industrial wastes, Waste water treatment.

Identifiers: Textile water reuse, Dyeing wastes.

Increasing demands for industrial and municipal water in the United Kingdom have prefaced this discussion on the reuse of industrial waste waters produced in the textile industry. Current methods of textile water renovation which are being investigated include hyperfiltration or reverse osmosis with polyamide (hollow fine fiber), cellulose acetate (spiral and tubular), and hydrous Zr (IV) oxide-polyacrylate membranes. Costs in the United Kingdom for treatment of textile effluents which are, by convention, treated by local authorities are discussed. Modifications to dyeing equipment to reduce water requirements are discussed. Techniques for conservation of process water used in the wool industry for scouring, rinsing, and dyeing processes are described. A method of dyeing in short liquors based on atomization which was developed by Ciba-Geigy is described. (Schulz-FIRL)

W78-01179

THE ORIGIN, TREATMENT AND DISPOSAL OF TANNERY EFFLUENTS,

D. A. Bailey.

Process Biochemistry, Vol. 12, No. 1, p 13-14, 17-18, 21-22, 24-25, January/February, 1977. 3 fig, 3 tab, 63 ref.

Descriptors: *Tannery wastes, *Effluents, *Chromium, *Sulfides, *Industrial wastes, Biological treatment, Activated sludge, Anaerobic conditions, Oxidation lagoons, Filtration, Sludge treatment, Sludge disposal, Waste water treatment, Water requirements, Waste water disposal, Waste storage.

Various aspects of the origin, treatment, and disposal of tannery wastes are described. Pretanning processes which are described include soaking, dehairing, liming, deliming, bating, and pickling. Tannery processes and the characteristics of wastes produced during dyeing, drying, and finishing are described. Quantities of water used for tanning processes and combined effluent characteristics are presented. Options for the disposal of the industrial effluents produced are compared. Methods of pretreatment prior to discharge to a municipal sewer system are described. Treatment methods for sulfide removal from dehairing and lime liquors with aeration are discussed. Processes for the removal and recovery of trivalent chromium are examined. Waste water

WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

Water Treatment and Quality Alteration—Group 5F

characteristics and available treatment methods are described for leather dressing wastes. The effects of tannery wastes on municipal waste water treatment processes are examined with respect to sulfides, trivalent chromium, anaerobic treatment, and biological processes. Previous studies on various treatment and disposal methods which have been applied to tannery wastes are described, including biological treatment, anaerobic treatment, land treatment and lagooning, high rate bio-filtration, activated sludge treatment, oxidation ditches, and other options for sludge treatment and disposal. (Schulz-FIRL)

W78-01181

THE ADSORPTIVE PURIFICATION OF EFFLUENTS WITH GRANULAR ACTIVATED ALUMINA (DIE ADSORBTIVE REINIGUNG VON ABWAESSERN MIT GEKOERNTER AKTIVTONERDE),
H. Hepp.
Vom Wasser, Vol. 47, p 179-185, 1977. 4 fig, 1 tab, 5 ref.

Descriptors: *Adsorption, *Organic wastes, *Humic acids, *Aluminum, *Chemical precipitation, *Industrial wastes, Lignin, Decaying organic matter, Filtration, Physical properties, Water treatment, Waste water treatment.

Identifiers: Granular activated alumina.

Laboratory experiments were used to evaluate the use of COMPALOX, a variety of granular activated alumina, for the treatment of industrial waste waters and potable water to remove soil-derived humic acids. Lignin sulfonic acid was used in laboratory tests on the adsorption of high molecular weight organic substances in industrial waste waters onto COMPALOX. The experiments indicated that pretreatment affected the degree of adsorption. The pH value of the feed to the system could be used to adjust the internal precipitation on the COMPALOX surface. Pore size distribution is a special feature of COMPALOX. (Schulz-FIRL)

W78-01182

5E. Ultimate Disposal Of Wastes

HOW RECENT FEDERAL LEGISLATION HAS MOVED TOWARD GREATER PROTECTION OF GROUNDWATER RESOURCES.
Geraghty and Miller, Inc., Port Washington, NY.
For primary bibliographic entry see Field 6E.

W78-00969

SANITARY LANDFILLS, A BIBLIOGRAPHY, VOLUME 2.

Office of Water Research and Technology, Washington, D.C.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-274 440. Price codes: A07 in paper copy, A01 in microfiche. Water Resources Scientific Information Center, Report OWRT/WRSIC 77-203, April 1977. 231 p.

Descriptors: *Landfills, *Bibliographies, *Abstracts, Information exchange, Groundwater, Leachate, *Path of pollutants, *Sludge disposal, Sludge treatment, Solid wastes, *Waste disposal, Waste water treatment, Water pollution sources.

This report, containing 259 abstracts, is another in a series of planned bibliographies in water resources produced from the information base comprising SELECTED WATER RESOURCES ABSTRACTS (SWRA). At the time of search for this bibliography, the data base had 104,878 abstracts covering SWRA through February 1977 (Volume 10, Number 4). Author and subject indexes are included. (See W72-13043 for Volume 1.)

W78-01004

APPLICATION OF ECOSYSTEM MODELING METHODOLOGIES TO DREDGED MATERIAL RESEARCH,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Effects, Lab. For primary bibliographic entry see Field 5A.

W78-01070

MECHANICAL DEWATERING OF SEDIMENTS FROM ROOFING BOARD FACTORY EFFLUENTS (OPYT MEKHANICHESKOGO OBEZVOZHIVANIYA OSADKOV STOCHNYKH VOD KARTONNO-RUBEROIDNYKH ZAVODOV),

Academy of Municipal Economy, Moscow (USSR). Research of Public Water Supply, Water Purification.

R. Ya. Agranonik, L. A. Sukhova, and V. R. Sheinkerman.

Stroitel'nye Materialy, No. 9, p 6-7, 1976. 1 tab, 2 ref.

Descriptors: *Sludge treatment, *Dewatering, *Centrifugation, Wastes, Industrial wastes, Pulp and paper industry, Sludge, Pulp wastes, Waste treatment, Water pollution sources, Water pollution control, Lime.

Identifiers: Polyacrylamide, Roofing felt(Roofing board).

Numerous studies conducted in recent years have shown that the best mechanical method of dewatering sludge from effluents of roofing felt factories is centrifugation. This method reduces the water content of the sludge to 59-67%; the sediment retention is 65-80%. Since 1969, the sludge-drying beds at many plants are being replaced by centrifugal equipment. Such equipment is presently in operation at 6 Soviet plants. The centrifuges used are of the horizontal endless screw type with a rotor 50 cm in diameter. In order to eliminate the detrimental effect of centrifuge recycled to the sedimentation tanks, the retention of sediment should be at least 80%. Thus, the main problem in operating the centrifuges is the increase of retention. This can be best achieved by the addition of coagulants to the sludge. Among several coagulants tested, polyacrylamide was the most effective, the amount required being 0.2%, based on dry solids weight. This amount can be reduced to 0.1% by simultaneous addition of 10% lime. (Stapinski-IPC)

W78-01120

CATALYTIC WASTE TREATMENT SYSTEMS FOR GREAT LAKE ORE CARRIERS,
Thiokol Corp., Brigham City, UT.

For primary bibliographic entry see Field 5D.

W78-01157

ELIMINATION OF POLLUTION FROM COTTAGE CHEESE WHEY BY DRYING AND UTILIZATION,

Dairy Research and Development Corp., Peekskill, NY.
For primary bibliographic entry see Field 5D.

W78-01167

UTILIZATION OF CHEESE WHEY FOR WINE PRODUCTION,
Oregon State Univ., Corvallis. Dept. of Food Science and Technology.

H. Y. Yang, F. W. Bodyfelt, K. E. Berggren, and P. K. Larson.

EPA-600/2-77-106. June 1977. 27 p, 2 fig, 7 tab, 7 ref.

Descriptors: *Fermentation, *Yeasts, *Dairy industry, *Food processing industry, *Recycling, Nutrient removal, Industrial wastes.

Identifiers: Whey, Wine production.

The use of whey as a fermentation substrate for wine production may offer economic advantages

to the dairy and wine industries, as well as a means of disposal for the 90 lbs of whey resulting from the production of 10 lbs of cheese. Whey was obtained from cheese plants in Oregon and Washington for a testing program on the production of whey wine. Studies on the effect of different wine yeast strains on the fermentation rate of whey wine indicated that Montrachet yeast fermented the fastest at 7 days, followed by Champagne, Sherry, Port, and Burgundy. Studies on the effect of fermentation temperatures on fermentation rate and wine flavor revealed that fermentation at room temperature (72 F) resulted in a time of 7 days for completion of fermentation and no adverse effects on taste. Sulfur dioxide at 100 ppm was recommended as a preservative which would not adversely affect flavor. Bentonite at 0.5% was suggested as a clarifying agent. Studies on the possibility of blending fruit and berry wines with whey wine and on the use of synthetic flavoring agents indicated that the raspberry-whey blend wine and the citrus-flavored whey wine were most favored by the participants in a sensory evaluation of whey wines. (Schulz-FIRL)

W78-01170

PYROLYSIS OF INDUSTRIAL WASTES FOR OIL AND ACTIVATED CARBON RECOVERY,
Occidental Research Corp., La Verne, CA.

F. B. Boucher, E. W. Knell, G. T. Preston, and G. M. Mallan.

EPA-600/2-77-091. May 1977. 181 p, 22 fig, 45 tab, 2 ref, 2 append.

Descriptors: *Ultimate disposal, *Pulp and paper industry, *Activated carbon, *Fuels, *Oils, Fibers(Plant), Bark, Trees, Heat treatment, Pilot plants, Animal wastes(Wildlife), Farm wastes, Industrial wastes, Waste disposal.

Identifiers: Pyrolysis, Synthetic fuel oils, Douglas fir, Rice hulls, Grass straw.

A four-phase study evaluated the use of a flash pyrolysis process developed by the Garrett Research and Development Company in La Verne, California, for the production of synthetic fuel oils from municipal and industrial wastes. Laboratory pyrolysis studies with a 5 lb/hr bench-scale reactor were used to examine the conversion of Douglas fir bark, rice hulls, grass straw, and animal feedlot wastes to synthetic fuel oil and activated carbon. Pilot plant studies examined the preparation of feedstock, production of start-up char by direct electrical heating from the reactor walls, product quality, optimum operating conditions, and product char properties. The final phase of the study presented an engineering process design and economic evaluation of the Garrett flash pyrolysis process for the conversion of Douglas fir bark to synthetic fuel oil and saleable char products in the form of briquettes or activated carbon. Acceptable products were obtained from all feedstocks except animal waste because of its high concentrations of nitrogen, sodium, and potassium. Designs are presented for a \$13.3 million, 12 dry ton/day tree bark conversion plant which could be operated for \$2.9 million per year at a profit of \$10/ton of dry bark. A bark quantity of 300 tons/day is recommended as the break-even point for the Garrett process. (Schulz-FIRL)

W78-01172

THE ORIGIN, TREATMENT AND DISPOSAL OF TANNERY EFFLUENTS,
For primary bibliographic entry see Field 5D.

W78-01181

5F. Water Treatment and Quality Alteration

IS YOUR SWIMMING POOL SAFE.
South African Bureau of Standards, Pretoria. SABS Bulletin, Vol. 6, No. 5, p 97-101, January 1977. 4 fig.

Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5F—Water Treatment and Quality Alteration

Descriptors: *Swimming pools, Safety hazards.

A code of practice for the safeness of swimming pools on private premises has been prepared by the South African Bureau of Standards. The code lays down responsibilities, principles, methods and planning techniques for the protection of children against the hazards of swimming pools on private premises, and makes recommendations for the design and installation of typical protective devices that are intended to prevent children from gaining unauthorized access to a swimming pool. Enclosures, gates, pool covers and warning devices are discussed in detail. (So. African Water Info. Center) W78-00932

OZONE: THE WATER CONDITIONING PROCESS OF THE FUTURE TODAY,
Airon Industries, Inc., Rochester, NY.

A. Burris.

Water Well Journal, Vol 31, No 10, p 38-40, October, 1977.

Descriptors: *Ozone, *Water treatment, Water purification, Chlorination, Viruses.

Identifiers: *Individual water systems, Point-of-use water treatment.

Although ozone has been applied to water treatment since the late 1800's and has shown success in large cities throughout the world, only a few American municipalities have used ozone, partly because of a tradition that has enshrined chlorine. Interest in ozone has grown in the U.S., however, because of ozone's superiority to chlorine in several areas: it kills viruses whereas conventional chlorination does not, it does not produce carcinogenic, toxic, and odiferous chlorinated hydrocarbons as byproducts, and it is capable of rendering many common chemical pollutants harmless. Ozone treatment is particularly adaptable to individual water systems. Its many advantages include simplicity, purification without chemical additives, no dosage control problems, and effectiveness over a wide pH range. Initial capital cost for an ozone system is higher than for other treatment systems, but this cost is offset by savings on chemical supplies over a period of years. (Eberle-NWWA) W78-00933

REMOVING IRON FROM A WATER SUPPLY,
National Water Well Association, Worthington, OH.

T. E. Gass.

Water Well Journal, Vol 31, No 10, p 35-36, October, 1977.

Descriptors: *Groundwater, *Water treatment, *Iron compounds, *Water wells, *Iron bacteria, Ion exchange, Filtration, Oxidation, Water softening, Chlorination.

Although iron in a well supply does not normally constitute a health hazard, concentrations of 0.3 ppm or greater can prove very unattractive esthetically and can lead to serious damage of an individual water system. Three basic methods available to eliminate or reduce iron water problems are ion exchange, oxidation-filtration, and chlorination-filtration. In-depth analysis of the specific well problem is necessary before selecting any one method. For ferrous iron concentrations of 5 ppm or less, ion exchange units are adequate. Customarily used in areas with hardness problems, such units operate by exchanging sodium for iron to convert ferrous bicarbonate to sodium bicarbonate. For concentrations of 5-20 ppm, oxidation-filtration by means of a filter bed impregnated with manganese dioxide can frequently be accomplished. For concentrations greater than 20 ppm, chlorination followed by filtration is the most dependable method of removing dissolved iron, and is the only practical means of eliminating iron bacteria from the water. Amount of water

used per week, maximum rate of flow, and pH of the water supply source must all be taken into consideration when designing the iron treatment system and scheduling maintenance operations. (Eberle-NWWA) W78-00954

UNDERGROUND INJECTION PROGRAM SET UNDER SAFE DRINKING WATER ACT,
New Mexico State Univ., University Park.
For primary bibliographic entry see Field 6E. W78-00955

IMPACT OF ABANDONED WELLS ON GROUND WATER,
National Water Well Association, Worthington, OH.

For primary bibliographic entry see Field 6E. W78-00968

THE ACTIVITY OF TRACE METALS IN AQUEOUS SYSTEMS AND THE EFFECT OF CORROSION CONTROL INHIBITORS,
Albuquerque Univ., NM.

For primary bibliographic entry see Field 8G. W78-01057

5G. Water Quality Control

USE OF SALT (NaCl) WATER TO REDUCE MORTALITY OF CHINOOK SALMON SMOLTS, ONCORHYNCHUS TSHAWYTSCHA, DURING HANDLING AND HAULING,
National Marine Fisheries Service, Seattle, WA. Northwest Fisheries Center.

C. W. Long, J. R. McComas, and B. H. Monk. Marine Fisheries Review, Vol. 39, No. 7, p. 6-9, 1977. 9 fig. 10 ref.

Descriptors: *Mortality, *Salinity, *Columbia River, *Saline water, *Salt tolerance, *Fish diseases, *Chinook salmon, *Smolt, *Fungi, *Pathogenic fungi, Water chemistry, Salts, Metabolism, Sodium compounds, Fish physiology, Fish stocking, Fish passages, Fish barriers, Juvenile growth stage, Aquaculture, Washington. Identifiers: *Snake River (Wash), *Saprolegnia.

A major research program on the Columbia and Snake Rivers was designed to increase survival of juvenile salmon and trout by capturing them at an upriver dam, transporting them around a series of dams, and releasing them into the Columbia River. Excellent results have been obtained with steelhead trout, *Salmo gairdneri*. However, the mortality of chinook salmon, *Oncorhynchus tshawytscha*, immediately following their transportation adversely affected the percentage that return as adults. In a small-scale study conducted in 1975 at Bonneville Dam, adding salt (NaCl) to the water during handling and hauling increased the survival of juvenile chinook salmon and protected test fish against *Saprolegnia* spp., a fungus that infected several of the control fish. The addition of salt to the water in future transportation studies should reduce delayed mortality of juvenile chinook salmon and thereby increase the percentage that return as adults. (Katz) W78-00909

TOXICITY TO FISH OF CYANIDES AND RELATED COMPOUNDS -- A REVIEW,
Oregon State Univ., Corvallis. Dept. of Fisheries and Wildlife.

For primary bibliographic entry see Field 5C. W78-00927

REPORT OF THE UNITED NATIONS WATER CONFERENCE, MAR DEL PLATA, 14-25 MARCH 1977.

United Nations Water Conference, New York. For primary bibliographic entry see Field 6E.

W78-00972

WATER POLLUTION INVESTIGATION: LOWER GREEN BAY AND LOWER FOX RIVER,
Wisconsin Dept. of Natural Resources, Madison. Div. of Environmental Standards.
For primary bibliographic entry see Field 5B. W78-01022

METHODS FOR IDENTIFYING AND EVALUATING THE NATURE AND EXTENT OF NON-POINT SOURCES OF POLLUTANTS.
Environmental Protection Agency, Washington, DC. Office of Air and Water Programs.
For primary bibliographic entry see Field 5B. W78-01024

NUMERICAL MODELING OF POLLUTANT TRANSPORT USING A LAGRANGIAN MARKER PARTICLE TECHNIQUE,
Rhode Island Univ., Kingston.

M. Spaulding.
Available from the National Technical Information Service, Springfield, VA 22161 as N76-28682. Price codes: A03 in paper copy, A01 in microfiche. NASA Technical Memorandum, NASA TM X-73930, National Aeronautics and Space Administration, Langley Research Center, Hampton, Virginia, August 1976. 33 p, 11 fig, 2 tab, 14 ref.

Descriptors: *Water pollution control, *Numerical analysis, *Simulation analysis, Pollutants, Wastes, Coasts, Analytical techniques, Flow, Sediments, Equations, Algorithms, Mathematical models, Systems analysis.

Identifiers: *Waste discharge.

A derivation and code have been developed for the three-dimensional mass transport equation, using a particle-in-cell solution technique, to solve coastal zone waste discharge problems where particles are a major component of the waste. Improvements in the particle movement techniques have been suggested and typical examples illustrated. Preliminary model comparisons with analytic solutions for an instantaneous point release in a uniform flow have shown good results in resolving the waste motion. Findings indicate that this computational model will provide a useful technique to study the motion of sediment, dredged spoils, and other particulate waste loads commonly deposited in coastal waters. (Bell-Cornell) W78-01069

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

MATHEMATICAL MODELING OF NATURAL GROUNDWATER RECHARGE,
Utah International Inc., San Francisco, CA. Environmental Quality Dept.

For primary bibliographic entry see Field 2F. W78-00974

IMPROVED PROCEDURES FOR VALUATION OF THE CONTRIBUTION OF RECREATION TO NATIONAL ECONOMIC DEVELOPMENT,
Illinois Univ. at Urbana-Champaign. Dept. of Forestry.

For primary bibliographic entry see Field 6B. W78-01003

WATER AND RELATED PROBLEMS IN COAL-MINE AREAS OF ALABAMA,
Geological Survey, Tuscaloosa, AL. Water Resources Div.

For primary bibliographic entry see Field 5B.

W78-010

6B. E

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WATER RESOURCES PLANNING—Field 6

Water Law and Institutions—Group 6E

W78-01094

6B. Evaluation Process

IRRIGATION OF SUGAR CANE,
South African Sugar Association Experiment Station, Mount Edgecombe.
For primary bibliographic entry see Field 3F.
W78-00928

LEAST COST IRRIGATION SYSTEM SPECIFICATIONS FOR VARIOUS CONDITIONS,
Idaho Univ., Moscow. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 3F.
W78-00973

IMPROVED PROCEDURES FOR VALUATION OF THE CONTRIBUTION OF RECREATION TO NATIONAL ECONOMIC DEVELOPMENT,
Illinois Univ. at Urbana-Champaign. Dept. of Forestry.

J. F. Dwyer, J. R. Kelly, and M. D. Bowes.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-274 446, Price codes: A11 in paper copy, A01 in microfiche. Illinois Water Resources Center, Urbana, Research Report No 128, September 1977. 218 p., 13 fig., 17 tab., 18 ref., 5 append. OWRT C-7525(6237)(1).

Descriptors: *Recreation, *Benefits, *Economics, *Evaluation, *Methodology, Water utilization, Water users, *Cost analysis, *Cost-benefit analysis, Value, Assessments.

Identifiers: *National economic development, Consumers' surplus, Travel cost method, Interview method, Unit day values, *Willingness-to-pay functions, Valuation procedures.

Improved procedures are presented for evaluating the contribution of recreation to national economic development. These procedures are to replace those outlined in the Principles and Standards for Planning Water and Related Land Resources. (See W74-09278) Desirable criteria for valuation procedures are specified. Variation procedures currently used by federal agencies make almost exclusive use of the 'interim unit day value approach,' sometimes augmented by point systems. This approach has little theoretical or empirical justification and modification of the 'interim unit day value approach' and the use of point systems is not a useful method of developing improved procedures. Rather, it is recommended that models be developed to predict individual willingness-to-pay for many types of recreation as functions of site characteristics, the characteristics of the individual user (including the history of previous use), the availability of substitute activities and sites, and the location of the individual in relation to the resources under study. The total value of the resource would then be a function of these variables, the number of users, and the distribution of users within the market areas. These functions may be derived from regional travel cost demand functions (which would also provide estimates of use) or could be explicit willingness-to-pay functions derived from the survey method (which must be supplemented by a use estimate). Examples of the desired models are provided along with guidelines for their development and use. Needs for further research are identified.
W78-01003

TURNING BACK THE TIDES OF LONG-TIME FEDERAL WATER POLICY,
For primary bibliographic entry see Field 6E.
W78-01044

DRAINING THE WATER PROJECTS OUT OF THE PORK BARREL,
For primary bibliographic entry see Field 4A.

W78-01045

HIKER PERCEPTION OF WILDERNESS: A STUDY OF THE SOCIAL CARRYING CAPACITY OF THE GRAND CANYON,
Arizona Univ., Tucson. Div. of Economic and Business Research.

W. Towler.
Arizona Review, Vol. 26, Nos. 8-9, p 1-10, August-September, 1977, 1 fig., 2 tab., 15 ref.

Descriptors: *Recreation, *Arizona, *Environmental effects, *Evaluation, *Recreation facilities, *National parks, Environment, Colorado River, Social needs, Social participation, Conservation, Public lands, Attitudes, Land management, Surveys, Camp sites, Land use.
Identifiers: Grand Canyon.

A study was conducted to determine the socio-economic and demographic characteristics and motivations of trail users in the Grand Canyon National Park, Arizona. An additional purpose was to measure the perception of several attributes of wilderness in the Wilderness Act of 1964. Questionnaires were mailed to users of wilderness permits in 1976. The study draws its conclusions from the 252 responses. Almost every hiker on the wilderness trails perceives the inner canyon as a wilderness area and most feel that man's impact should be minimal. There is overwhelming support for the present National Park Service policy of limiting use on wilderness trails and requiring every backcountry traveler to obtain a permit before entering the canyon. A high proportion of hikers also object to seeing motorized rafts on the Colorado River, and many complained of large groups traveling together, especially in areas where hikers interact with large river raft parties. (Jamaal-Arizona)
W78-01047

COMPARATIVE ASSESSMENT OF WATER USE AND ENVIRONMENTAL IMPLICATIONS OF COAL SLURRY PIPELINES,
Geological Survey, Reston, VA. Water Resources Div.

For primary bibliographic entry see Field 8A.
W78-01085

WATER CONSUMPTION BY NUCLEAR POWERPLANTS AND SOME HYDROLOGICAL IMPLICATIONS,
Geological Survey, Reston, VA. Water Resources Div.

For primary bibliographic entry see Field 7C.
W78-01097

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

WASTE-WATER TREATMENT: ECOLOGICAL, TECHNOLOGICAL AND ECONOMIC ASPECTS (IN GERMAN),
For primary bibliographic entry see Field 5D.
W78-01163

6D. Water Demand

THE IMPACT OF SECOND-HOME DEVELOPMENT ON WATER AVAILABILITY IN NORTH CENTRAL ARIZONA,
Arizona State Univ., Tempe. Bureau of Business and Economic Research.
For primary bibliographic entry see Field 4C.
W78-01052

WATER CONSUMPTION BY NUCLEAR POWERPLANTS AND SOME HYDROLOGICAL IMPLICATIONS,
Geological Survey, Reston, VA. Water Resources Div.

For primary bibliographic entry see Field 7C.
W78-01097

PUBLIC WATER SUPPLIES OF SELECTED MUNICIPALITIES IN FLORIDA, 1975,
Geological Survey, Tallahassee, FL. Water Resources Div.

H. G. Healy.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-271 691/AS, price codes: A14 in paper copy, A01 in microfiche. Water-Resources Investigations 77-53, July 1977. 309 p., 28 fig., 6 tab., 57 ref.

Descriptors: *Water supply, *Municipal water, *Florida, *Surface waters, *Groundwater resources, Aquifers, Water yield, Water utilization, Water quality, Water demand, Cities, Population, Growth rates, Water consumption(Except consumptive use), Reviews, Evaluation.

Water use by 169 municipalities and 5 county water systems in Florida as of December 1975 is summarized. Included in the listing, by city or system, are water use data, sewage data, and chemical analyses of raw and treated water. In addition, miscellaneous public supply data for three small communities and municipalities (population generally less than 5,000) and historical public supply pumpage for selected municipalities for 1945, 1947, 1956, 1965 and 1970-74 are tabulated. Also included is a list of reports published in 1970-75 relating to hydrology, geology, and water resources of the areas where the cities are located. The demand for freshwater for municipal use in Florida increased sharply during 1970-75. Statewide ground-water use for municipal supply increased from 759 mgd in 1970 to 976 mgd in 1975 and surface-water use has increased from 125 mgd in 1970 to 166 mgd in 1975. The 28 percent increase in ground-water use and the 33 percent increase in surface-water use reflects the continuing rapid population growth and the accompanying expanding economic activity in the State. (Woodard-USGS)
W78-01098

6E. Water Law and Institutions

UNDERGROUND INJECTION PROGRAM SET UNDER SAFE DRINKING WATER ACT,
New Mexico State Univ., University Park.
J. W. Hernandez.

Water and Sewage Works, Vol 124, No 10, p 67-69, October, 1977.

Descriptors: *Injection wells, *Waste disposal, *Water pollution sources, *Groundwater, Water pollution control, Aquifers, Water supply, Potable water.

Identifiers: *U.S. Environmental Protection Agency, *Underground Injection Control, *National Safe Drinking Water Act, Federal Water Pollution Control Act.

The future safety of existing and potential water supply aquifers was one of the principal concerns voiced by Congress in the passage of Public Law 93-523, the National Safe Drinking Water Act of 1974. Although some control of ground water pollution was provided in 1972 through Public Law 92-500, Congress felt that greater protection should be afforded ground water sources of public water supplies, protection that was thus provided in sections 1421-23 of PL93-523 requiring designated states to adopt regulations to control underground injection of pollutants. These states have enforcement responsibility for ground water protection, their injection-control programs being subject to approval by the U.S. EPA. In certain

Field 6—WATER RESOURCES PLANNING

Group 6E—Water Law and Institutions

cases, EPA may, on its own initiative, place constraints on projects in an area having an aquifer which is the sole or principal drinking water supply for that area. More recently, proposed Underground Injection Control (UIC) regulations have been published by the EPA and have been the subject of various hearings across the nation. Questions raised regarding several definitions and the extensive reports required by injection well operators indicate that some modification of the regulations may be warranted. (Eberle-NWWA) W78-00955

POLICY IMPLICATIONS OF URBAN LAND PRACTICES FOR GROUNDWATER QUALITY,
American Inst. of Planners, Washington, DC.
For primary bibliographic entry see Field 4C.
W78-00958

NATIONAL WATER COMMISSION VIEWS GROUNDWATER PROTECTION,
Camp, Dresser and McKee, Belmont, CA. Water Resources Div.
For primary bibliographic entry see Field 4B.
W78-00966

ENVIRONMENTAL EFFECTS OF SEPTIC TANK SYSTEMS,
Robert S. Kerr Environmental Research Lab., Ada, OK.
For primary bibliographic entry see Field 5B.
W78-00967

IMPACT OF ABANDONED WELLS ON GROUND WATER,
National Water Well Association, Worthington, OH.
T. E. Gass, J. H. Lehr, and H. W. Heiss, Jr.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-272 665, Price codes: A04 in paper copy, A01 in microfiche. EPA-600/3-77-095, Ecological Research Series, August, 1977. 59 p, 3 fig, 20 ref, 2 append. R-803889.

Descriptors: *Wells, *Water pollution control, *Regulation, *Groundwater, Water wells, Oil wells, Drill holes, Well casings, Cement grouting, Legislation, Potable water, Waste disposal, Aquifers, Water pollution sources.
Identifiers: *Well abandonment, *Abandoned wells, *Well sealing.

Although it is recognized that unplugged abandoned wells are a hazard to our nation's potable groundwater supplies, the potential magnitude of the problem is still not fully understood. Case histories of several serious incidents of groundwater pollution due to improperly abandoned wells are discussed. Also provided is a survey of state laws concerning well abandonment procedures which exposes a disparity in such regulations in and among different states. Laws in the traditional oil-producing states are generally up-to-date and effective in dealing with abandoned wells. In the remainder of the states, well abandonment laws are ineffective or non-existent. By examining the model legislation guidelines that are presented, state and local authorities can gain insight and legislative perspective, which will enable them to formulate and enact effective laws to protect their ground water supplies. (Eberle-NWWA) W78-00968

HOW RECENT FEDERAL LEGISLATION HAS MOVED TOWARD GREATER PROTECTION OF GROUNDWATER RESOURCES.
Geraghty and Miller, Inc., Port Washington, NY.
Special Report, September, 1977. 7 p.

Descriptors: *Water pollution control, *Groundwater, *Waste disposal, *Water law, Water pollution sources, Injection wells, Toxins, Regulation, Pollutants.

Identifiers: Safe Drinking Water Act, Resource Conservation and Recovery Act, Toxic Substances Control Act.

Emphasis on the protection of one resource in an environmental network sooner or later results in transfer of stress to one or all of the neglected resources. Waste disposal regulations to prohibit contamination of air and surface water have thus made ground water a more vulnerable target for pollution. Over the past decade, legislative reaction to this situation has been a series of Acts which have progressively tightened regulations regarding ground water protection: the Safe Drinking Water Act (PL 93-523), the Resource Conservation and Recovery Act (PL 94-580), and the Toxic Substances Control Act (PL 94-469). EPA is now only beginning to implement some of the provisions of these Acts, but if they are fully enforced, the impact on ground water polluters could be substantial. (Eberle-NWWA) W78-00969

WATER WELL INDUSTRY CODES AND LICENSING.
Ground Water Age, Vol 10, No 9, p 20-25, May, 1976. 1 tab.

Descriptors: *Drilling, *Water wells, *Well regulations, Permits, Well casings, Plastic pipes.
Identifiers: Pump installation, Pitless adapters.

Ground Water Age completed is second annual survey of state agencies responsible for the water well drilling codes and licensing of well drilling contractors in 1976. Results are presented in tabular form. Four states, Connecticut, Illinois, South Dakota, and Vermont reported that they require a plumber's license in lieu of a well driller's license. (Eberle-NWWA) W78-00970

REPORT OF THE UNITED NATIONS WATER CONFERENCE, MAR DEL PLATA, 14-25 MARCH 1977.

United Nations Water Conference, New York.
UN Report E/CONF.70/29, 1977. 181 p, UN Sales No. E.77.II.A.12, \$7.00.

Descriptors: *Conferences, *United Nations, *Water resources development, *Assessments, Regional analysis, *Water utilization, Pollution abatement, *Water supply, Deserts, *Water policy, Agriculture, Institutions, Financing, Planning, Management, Water pollution, *Environment.
Identifiers: *UN Water Conference (Mar del Plata 1977), *Developing countries, *International cooperation.

The Mar Del Plata Action Plan made recommendations in the following areas: Assessment of water resources; Water use and efficiency; Environment, health and pollution control; Policy, planning and management; Natural hazards; Public information, education, training and research; Regional co-operation; International co-operation; Specific regional recommendations. It also stated resolutions on the following topics: Assessment of water resources; Community water supply; Agricultural water use; Research and development of industrial technologies; Role of water in combating desertification; Technical co-operation among developing countries in the water sector; River commissions; Institutional arrangements for international co-operation in the water sector; Financing arrangements for international co-operation in the water sector; Water policies in the occupied territories. W78-00972

TURNING BACK THE TIDES OF LONG-TIME FEDERAL WATER POLICY,
J. D. Kirschken.
National Journal, Vol. 9, No. 24, p 900-903, June 11, 1977.

Descriptors: *Water policy, *Federal-State Water Rights Conflicts, *Federal Project Policy, Federal Government, Water resources development, Water demands, Droughts, *Water conservation, U.S. Water Resources Council, Southwest, U.S. Administration agencies, Irrigation efficiency, Cost sharing.

Identifiers: Environmental Protection Agency, U.S. Army Corps of Engineers, Council on Environmental Quality, Office of Management and Budget.

President Carter's proposed comprehensive national water resources policy which would unite the efforts of 25 federal agencies presently dealing with water problems is discussed. Interior Secretary Cecil D. Andrus will lead the water policy review which has as its main purpose a more rational use of water. As many areas of the U.S. are dealing with serious drought conditions, Carter and his aids feel the time is ripe to convince Americans that wise management and conservation may be better answers to water problems than expensive construction projects. The Administration cut the budget for several water projects, but these cuts are being challenged by the legislative branch. Carter's five basic areas for water policy reform (water conservation, cost sharing, economic stimulus, project evaluation, and dam safety) are discussed. Among the reforms investigated are more efficient irrigation practices and new water pricing strategies. Three Federal agencies: Office of Management and Budget, Council on Environmental Quality, and the Water Resources Council are responsible for the water policy review. The impact of state and local water interests and the creation of a new Department of Natural Resources are also discussed. (Jamail-Arizona) W78-01044

DRAINING THE WATER PROJECTS OUT OF THE PORK BARREL.
For primary bibliographic entry see Field 4A.
W78-01045

ENVIRONMENTAL IMPACT ASSESSMENTS FOR U.S. AND CANADIAN INDUSTRIES,
Jordan (Edward C.), Inc., Portland, ME.
For primary bibliographic entry see Field 5C.
W78-01099

THE ROLE OF TOXIC COMPOUNDS IN THE REVISION OF THE 1983 EFFLUENT GUIDELINES,
Environmental Protection Agency, Washington, DC.
C. Vogt.

TAPPI Environmental Conference Papers, Chicago, April 25-27, 1977, (Preprinted Proceedings, TAPPI, Atlanta, Ga.), p 5-10, 5 tab.

Descriptors: *Legislation, *Toxicity, *Water quality standards, *Pulp wastes, Pulp and paper industry, Wastes, Industrial wastes, Water pollution sources, Effluents, Pollutants, Public health, Hazards, Waste water treatment, Waste treatment, Economics, Regulation, Water pollution.
Identifiers: Paper converting industry.

The U.S. Environmental Protection Agency (EPA) has established effluent limitations and standards for regulating the discharges from pulp, paper, and paperboard mills. The Agency recently signed a consent decree (June 1976) as a result of litigation brought about by five public interest groups. The consent decree requires the EPA to establish revised effluent limitations and standards regulating the discharge of up to 65 classes of pollutants from pulp, paper, and paperboard mills and converting plants. The regulations must be promulgated within three years and would be applicable to new facilities, to existing facilities (on or before 1983), and to users of publicly owned waste water treatment facilities. The EPA will set the effluent limitations and standards based upon studies

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RESOURCES DATA—Field 7
Data Acquisition—Group 7B

which the Agency has initiated to examine the health and environmental risks of the 65 classes of pollutants, alternative technologies for removal of the pollutants, and economic impacts of the regulations. (Witt-IPC)
W78-01122

6F. Nonstructural Alternatives

TURNING BACK THE TIDES OF LONG-TIME FEDERAL WATER POLICY,
For primary bibliographic entry see Field 6E.
W78-01044

6G. Ecologic Impact Of Water Development

REPORT OF THE UNITED NATIONS WATER CONFERENCE, MAR DEL PLATA, 14-25 MARCH 1977.
United Nations Water Conference, New York.
For primary bibliographic entry see Field 6E.
W78-00972

THE EFFECT OF LARGE DAMS ON RIVER WATER TEMPERATURE BELOW THE DAMS, WITH SPECIAL REFERENCE TO BILHARZIA AND THE VERWOERD DAM,
Bilharzia Field Research Unit, Nelspruit (South Africa).

R. J. Pitchford, and P. S. Visser.
South African Journal of Science, Vol 71, p 212-213, July 1975. 1 tab, 2 ref.

Descriptors: *Temperature effect, *Ecology, Snails, Bilharzia, Mollusks, Schistosomiasis, *Dam design, *Flow control, Sluices.
Identifiers: Verwoerd Dam, South Africa, Orange River, Fish River, Orange River Project.

The majority of large dams are constructed in such a way that the normal water out-flow from them into the rivers below is from sluices below the water surface level of the dam. Depending on the depth below surface level, temperatures of the out-flowing water might be very different from the normal water temperatures existing in comparatively shallow rivers. The effect of water temperature changes on fauna and flora ecology below the dam might be apparent for long distances downstream. Water temperature plays a vital role in Schistosome transmission (1) in permitting a suitable snail population to flourish and (2) in controlling the length of the incubation period of the parasite in the snail. Numerous situations might therefore arise which could alleviate or aggravate either the snail or the parasite population, or both, as a result of a permanent change of water temperature over large areas. Possible changes in the Orange and Fish Rivers due to the existence of the Verwoerd Dam are studied. (So. African Water Info. Center)
W78-00997

ENVIRONMENTAL INVENTORY AND ASSESSMENT OF NAVIGATION POOLS 24, 25, AND 26, UPPER MISSISSIPPI AND LOWER ILLINOIS RIVERS; SUMMARY REPORT,
Army Engineer Waterways Experiment Station, Vicksburg, Miss. Environmental Effects Lab.

R. C. Solomon, D. R. Parsons, D. A. Wright, B. K. Colbert, and C. Ferris.

Available from the National Technical Information Service, Springfield, VA 22161 as AD-A017 865, Price codes: A05 in paper copy, A01 in microfiche. Technical Report Y-75-1, November 1975. 97 p, 6 fig, 5 tab, 4 map, 46 ref.

Descriptors: *Environment, *Surveys, *Mississippi River, *Mississippi River basin, Geomorphology, Rivers, Vegetation, Wildlife, Aquatic life, Water quality, Sediments, Sediment

transport, Dams, Locks, Navigable rivers, Flood plains, Environmental effects, Vegetation effects, Trees, Wetlands, Habitats, Channel improvements, Dredging, Ecology, Stage-discharge relations, Dikes, Bank protection.
Identifiers: *Illinois River, Environmental inventories.

The River and Harbor Act of 3 July 1930 authorized the construction and maintenance of a 9-ft-deep by 300-ft-wide channel for commercial navigation of the Upper Mississippi and Lower Illinois Rivers. Construction of locks and dams supplemented by dredging and bank stabilization was required to maintain the 9-ft depth, particularly during periods of low flow. An investigation was performed by Colorado State University to evaluate the river reaches before and after man-made changes and overall changes in geomorphology. Additionally, trends of future geomorphic changes that could result from existing and potential future developments were addressed with the aid of a mathematical simulation model. Vegetation and vegetative successional patterns of the floodplain were characterized by the Missouri Botanical Gardens. Vegetation maps were produced delineating vegetational communities adjacent to the rivers and on islands. An inventory of the animals and their habitats was conducted by Southern Illinois University. Seven habitats were distinguished in the unprotected floodplain. Based on literature, 49 species of mammals, 286 species of birds, and 81 species and subspecies of amphibians and reptiles were expected to occur in the study area. Members of the Waterways Experiment Station study team collected water and sediment samples for chemical and physical analysis and biological samples from four habitat types. The data were subjected to various statistical analyses to determine if there were differences between habitats and sampling dates. Fish samples were collected from the Illinois River by the Illinois Natural History Survey and results were compared with literature to determine temporal and spatial changes in distribution. The overall impacts of operation and maintenance of the 9-ft channel were discussed relative to the effects on the biological, chemical, and physical system in the study area. Recommendations were made for further studies that are needed to define impact more adequately. (Sims-ISWS)

W78-01028

The majority of large dams are constructed in such a way that the normal water out-flow from them into the rivers below is from sluices below the water surface level of the dam. Depending on the depth below surface level, temperatures of the out-flowing water might be very different from the normal water temperatures existing in comparatively shallow rivers. The effect of water temperature changes on fauna and flora ecology below the dam might be apparent for long distances downstream. Water temperature plays a vital role in Schistosome transmission (1) in permitting a suitable snail population to flourish and (2) in controlling the length of the incubation period of the parasite in the snail. Numerous situations might therefore arise which could alleviate or aggravate either the snail or the parasite population, or both, as a result of a permanent change of water temperature over large areas. Possible changes in the Orange and Fish Rivers due to the existence of the Verwoerd Dam are studied. (So. African Water Info. Center)
W78-01028

7. RESOURCES DATA

7A. Network Design

HYDROLOGIC ANALYSIS AND RIVER-QUALITY DATA PROGRAMS,
URS Co., Seattle, WA.; and Geological Survey, Portland, Or. Water Resources Div.
W. G. Hines, D. A. Rickert, and S. W. McKenzie. Journal of the Water Pollution Control Federation, Vol 49, No 9, p 2031-2041, September 1977. 1 fig, 1 tab, 7 ref.

Descriptors: *Water quality, *Investigations, *Rivers, *Analytical techniques, *Data collections, Natural streams, Environmental effects, Flow control, Water pollution sources, Streams, Physical properties, Water temperature, Regression analysis, Evaluation, Network design, Synoptic analysis.

A unified approach is described for the collection of river-quality data. River-quality sampling and analysis programs can be dramatically improved through a de-emphasis of the routine monitoring approach and added emphasis on the following: (1) A competent analysis of the natural and man-controlled aspects of river hydrology as reflected by streamflow and water-temperature pattern and channel morphology, (2) The reanalysis of existing quality data, after their segregation into compatible temporal and spatial units, as derived from the

hydrologic analysis, and (3) The use of repetitive synoptic studies tailored to the environmental conditions and problems of interest in each river basin. (Woodard-USGS)
W78-01079

7B. Data Acquisition

MEASUREMENT OF PERIODIC OPEN AND SHUT SHELL MOVEMENT OF BIVALVES BY THE STRAIN-GAUGE METHOD,
Tokai Region Fisheries Research Lab., Shiogama (Japan).
T. Fujii.

Bulletin of the Japanese Society of Scientific Fisheries, Vol 43, No 7, p 901, 1977. 1 fig, 7 ref.

Descriptors: *Instrumentation, Equipment, *Strain gauges, Measurement, *Mollusks, *On-site collections, *Biorhythms, Behavior, Analytical techniques, Testing, Frequency, Cycles, Methodology, Laboratory tests.
Identifiers: Quantitative methods, *Tapes japonica.

In this study strain-gauges were adapted to the task of measuring the periodic open and shut movements of the bivalve, *Tapes japonica*. The advantages and disadvantages of this method of quantifying shell movements in the organism's natural environment were discussed. (Katz)
W78-00911

A PLEXIGLASS SUBSAMPLING BOX FOR LARGE BENTHOS SAMPLES,
QLM Labs., Inc., Oswego, NY.
R. P. Klattenberg.

The Progressive Fish Culturist, Vol 37, No 3, p 165, 1975.

Descriptors: *Sampling, *On-site data collections, *Benthic fauna, *Benthic flora, *Benthos, Invertebrates, *Equipment, *Research equipment, Research and development, Design, Cladophora, Metrology, Onsite investigations.

The construction of a plexiglass subsampling box designed to reduce the time required to pick and sort large benthos samples was described. The box was designed primarily for *Cladophora* samples, but could be easily adapted for other uses. (Katz)
W78-00913

A QUANTITATIVE SAMPLER FOR AQUATIC MACROPHYTES,
Natal Univ., Pietermaritzburg (South Africa).
Dept. of Botany.
C. M. Breen, C. Lillig, J. Oliver, and H. D. Furness.

Journal of the Limnological Society of Southern Africa, Vol. 2, No. 2, p 59-62, 1976. 3 fig, 13 ref.

Descriptors: *Aquatic plants, Macrophytes, *Submerged plants, *Sampling, Design data, Equipment.
Identifiers: *Potamogeton crispus*, *Nymphaea capensis*, *Ceratophyllum demersum*.

A sampler which can be operated single-handed from a boat is described. It is electrically powered and cuts a vertical column of weed as it is lowered through the water. On reaching the bottom, a second system is operated which severs the material. All cut material is retained within the sampler by a system of nets. Results from tests of the effectiveness in three different macrophyte communities are presented. In dense growths, seven samples yield a standard error of less than 10% of the mean. Although the sampler is fairly heavy and may appear cumbersome, it is easily operated by one person in a fairly light boat. Its real advantage is that it samples a defined column, unlike samplers which adopt hooks or grabs as the harvesting principle. It has been used extensively

Field 7—RESOURCES DATA

Group 7B—Data Acquisition

to yield very satisfactory estimates of seasonal changes in the standing crop of various aquatic macrophytes. (So. African Water Info. Center) W78-00929

NEUTRON LOGGING METHOD FOR LOCATING THE TOP OF CEMENT BEHIND BOREHOLE CASING,

Oil and Natural Gas Commission, Madras (India).

A. E. Ahmed.

Journal of Petroleum Technology, Vol 29, No 9, p 1089-1090, September, 1977. 4 ref.

Descriptors: *Borehole geophysics, *Logging(Recording), *Cement grouting, Well casings.

Identifiers: *Neutron logging.

Several methods are available today for determining the top of the cement in the annulus around a well casing. Temperature logging and cement bond logging are among the techniques that are used successfully. A new technique involving a neutron log is presented as an alternative for when temperature or cement bond logging is impossible. Besides being sensitive to hydrogen present in borehole fluid and the fluid in the pores of rocks, the neutron log is also sensitive to casing, cement sheath, and borehole diameter. As the neutron device is pulled up in a borehole, a detectable shift in the recorded curve is registered when the tool passes the cemented zone of casing. This neutron method was tested on a well in the Cambay Basin, India, and showed acceptable results. (Eberle-NWWA) W78-00965

MICROWAVE REMOTE SENSING OF SOIL WATER CONTENT,

Kansas Univ./Center for Research, Inc., Lawrence. Remote Sensing Lab.

For primary bibliographic entry see Field 2G.

W78-01056

DETECTION OF SOIL MOISTURE AND SOIL CHARACTERISTICS FROM SKYLAB,

Kansas Univ./Center for Research, Inc., Lawrence. Space Technology Center.

J. R. Eagleton, E. C. Pogge, and R. K. Moore.

Available from the National Technical Information Service, Springfield, VA 22161 as N76-16556, Price codes: A14 in paper copy, A01 in microfiche. Final Report 239-23, October 1975. 312 p, 122 fig, 24 tab, 63 ref, 1 append. NASA NAS-13273.

Descriptors: *Remote sensing, *Soil moisture, *Snow cover, *Instrumentation, *Satellites(Artificial), Soil water, Moisture content, Photography, Microwaves, Radar, Radiation, On-site investigations, Data processing.

Identifiers: *Skylab, *Radiometers, Snow characteristics.

The Skylab soil moisture experiment was designed to evaluate the response of the various microwave sensors on Skylab to changing soil moisture patterns on earth. Detailed soil moisture information was collected from test sites in western Texas and eastern Kansas. A total of 2,250 soil samples was collected at 375 different sites and at six layers at each site so that the moisture content of the surface to 15 cm was obtained by 2.5 cm increments. The geographical distribution of soil moisture patterns was obtained throughout the test sites for comparison with the microwave sensors. The response of the S194 L-band radiometer to changing soil moisture conditions was very good for the five complete data sets consisting of three passes across Texas and two passes across Kansas. The comparisons between the L-band radiometer and soil moisture content within the footprint of the radiometer gave correlation coefficients ranging from -0.99 to -0.95 for these five data sets. The performance of the S193 passive radiometer was less consistent than that of the S194 L-band radiome-

ter; however, a data set gave a very high correlation of -0.95. Two data sets were obtained for determine the microwave response to snow characteristics. The S193 scatterometer data indicated a positive correlation between snow depth and scattering coefficient; the variability, however, of the relationship was so great that other factors are clearly important. (Sims-ISWS) W78-01058

COMPUTER-AIDED ANALYSIS OF SKYLAB MULTISPECTRAL SCANNER DATA IN MOUNTAIN TERRAIN FOR LAND USE, FORESTRY, WATER RESOURCE, AND GEOLOGIC APPLICATIONS,

Purdue Univ., Lafayette, IN. Lab. for Applications of Remote Sensing.

R. M. Hoffer.

Available from the National Technical Information Service, Springfield, VA 22161 as N76-19509, Price codes: A17 in paper copy, A01 in microfiche. Final Report, LARS Information Note 121275, December 12, 1975. 394 p, 104 fig, 48 tab, 49 ref. NASA NAS-13380.

Descriptors: *Remote sensing, *Satellites(Artificial), *Mountains, *Colorado, Land use, Forests, Forestry, Geology, Water resources, Snow cover, Clouds, Computers, Analytical techniques, Infrared radiation, Topography, Geomorphology, Hydrology.

Identifiers: *Skylab, *San Juan Mountains(Colo).

Results are described of an interdisciplinary research project involving the analysis of SKYLAB data obtained over the San Juan Mountains in Colorado. Computer-aided analysis techniques were applied to the S-192 MSS data for purposes of mapping land use, forest cover types, and hydrologic and geologic features of significance. In spite of the vegetative and topographic complexity of the test site, computer classification accuracies of 85% and 71% were obtained for Level II Land Use maps and Forest Cover maps, respectively. Accurate acreage estimates of forest cover were obtained by computer analysis of SKYLAB S-192 data. A detailed wavelength band study clearly indicated the importance of the near infrared wavelengths for vegetation mapping. The value of the improved spectral resolution of the SKYLAB MSS, as compared to LANDSAT, was also shown. SKYLAB MSS data clearly showed for the first time that the middle infrared wavelengths are essential for reliably separating snow from clouds on the basis of spectral response. Forest density and snow melt differences within the snowpack area could be mapped through use of the near infrared wavelengths. Calibration of the thermal infrared band allowed the surface temperature of a high elevation reservoir to be determined accurately from space. Geologic mapping, involving a variety of ratioing and classification techniques, indicated the need for additional study to define better the theoretical basis for use of these analysis procedures, in order to obtain reliable, predictable results. (Sims-ISWS) W78-01059

AVALANCHE RELEASE AND SNOW CHARACTERISTICS, SAN JUAN MOUNTAINS, COLORADO.

Colorado Univ., Boulder. Inst. of Arctic and Alpine Research.

For primary bibliographic entry see Field 2C.

W78-01062

SAMPLING OF INDUSTRIAL WASTEWATER HELPS MEET DISCHARGE STANDARDS,

Clinton Bogert Associates, Fort Lee, NJ.

A. F. Milletari.

Water and Wastes Engineering, Vol. 14, No. 10, p 52, 55-57, October, 1977. 3 fig.

Descriptors: *Sampling, *Monitoring, *Flow measurement, *Water measurement, *Analytical techniques, On-site data collections, Water analysis, Laboratory tests, Industrial wastes, Waste water treatment, Pumps.

Identifiers: Industrial waste water sampling.

Industrial waste water sampling and monitoring programs are useful in controlling in-plant operations and insuring compliance with water quality regulations. Various aspects of waste water sampling are discussed: location; techniques; equipment; sample preservation; sampling schedules; and basic methods of sampling such as grab sampling, simple composite sampling, discrete composite sampling, and continuous monitoring. Simple grab sampling can be used to characterize waste water generally for a given time when concentration and flow are relatively constant. Simple composite grab sampling obtains representative cross-sections of waste water characteristics. Methods of obtaining flow-proportioned composite samples are described. The use of automatic sampling devices for discrete and continuous sampling is discussed and various types of flowmeters are described. Safety precautions which should be observed during field sampling are presented. (Schulz-FIRL) W78-01073

COMPARISON OF DIFFERENT METHODS FOR ESTIMATING SNOWCOVER IN FORESTED, MOUNTAINOUS BASINS USING LANDSAT (ERTS) IMAGES,

Geological Survey, Tacoma, WA. Water Resources Div.; and Stanford Research Institute, Menlo Park, CA.

M. F. Meier, and W. E. Evans.

In Operational Applications of Satellite Snow-cover Observations; Report No NASA SP-391. Proceedings of workshop held August 18-20, 1975, South Lake Tahoe, California, p 215-234, 1975. 9 fig, 4 tab, 9 ref.

Descriptors: *Snow cover, *Estimating, *Satellites(Artificial), *Oregon, *Forests, Remote sensing, Analytical techniques, Snowpacks, Snow surveys.

Snow-covered areas on LANDSAT (ERTS) images of the Santiam River basin, Oregon, and other basins in Washington were measured using several operators and methods. Seven methods were used: (1) Snowline tracing followed by measurement with planimeter, (2) mean snowline-altitudes determined from many locations, (3) estimates in 2.5×2.5 km boxes of snow-covered area with reference to snow-free images, (4) single radiance-threshold setting locally edited by reference to altitude contours and other images, (6) two-band color-sensitivity extraction locally edited as in (5), and (7) digital (spectral) pattern recognition techniques. Methods (4), (5), and (6) used the SRI Electronic Satellite Image Analysis Console (ESIAC). The seven methods are compared in regard to speed of measurement, precision, the ability to recognize snow in deep shadow or in trees, relative cost, and whether useful supplemental data (such as the distribution of snow-covered areas with location or altitude) are produced. Standard errors range from about 3 to over 12 percent of the basin area depending on method and the fraction of the basin which is snow covered. (See also W77-10662) (Woodard-USGS) W78-01095

ADVECTION IN THE PERU CURRENT AS OBSERVED BY SATELLITE,

Hawaii Univ., Honolulu. Dept. of Oceanography.

K. Wyrtki.

Journal of Geophysical Research, Vol. 82, No. 27, p 3939-3943, September 20, 1977. 10 fig, 11 ref.

Descriptors: *Ocean currents, *Water temperature, *Remote sensing, *South America, *Pacific Ocean, *Satellites(Artificial), Oceans, Tempera-

RESOURCES DATA—Field 7
Evaluation, Processing and Publication—Group 7C

ture, Advection, Circulation, Water circulation, Ocean circulation, Oceanography.
Identifiers: *El Nino, *Chile.

Two years of satellite-derived maps of sea surface temperature were used to evaluate their oceanographic applications and to study advection in the eastern part of the subtropical gyre of the South Pacific Ocean. The advance and retreat of a tongue of cool water stretching from the coast of Chile to the northwest under the southeast trade winds were analyzed and explained as advection. The time history of the development of this cool tongue was described, and its different behavior during two years was related to the 1976 El Nino event. During 1976, advection in the subtropical gyre was much weaker than during the year before. It was concluded that satellite-derived surface temperature maps form an important new tool in the analysis and monitoring of the time changes of large-scale thermal features at the surface of the ocean. (Sims-ISWS)
W78-01137

A HIGH-RESOLUTION ELECTRONIC RAIN-FALL INTENSITY RECORDER AND TOTALISER.

Meteorological Office, Poona (India).
For primary bibliographic entry see Field 2B.
W78-01142

USER REQUIREMENTS AND USER ACCEPTANCE OF CURRENT AND NEXT-GENERATION SATELLITE MISSION AND SENSOR COMPLEMENT, ORIENTED TOWARD THE MONITORING OF WATER RESOURCES,

Ecosystems International, Inc., Gambrills, MD.
P. A. Castruccio, H. L. Loats, T. R. Fowler, and P. Robinson.

Available from the National Technical Information Service, Springfield, VA 22161 as N76-15552, Price codes: A05 in paper copy, A01 in microfiche. Report ECC 75: C-3-IV, December 15, 1975. 92 p., 17 fig, 6 tab, 11 ref. NASA NAS-20567.

Descriptors: *Remote sensing, *Satellites(Artificial), *Surveys, *Water resources, Water users, Watersheds(Basins), Drainage, Vegetation, Reservoirs, Flood plains, Rainfall, Snow cover, Topography, Instrumentation, Equipment, Water resources development. Identifiers: *LANDSAT, *User surveys, Sensors.

Principal water resources users were surveyed to determine the applicability of remotely sensed data to the user's present and future requirements. Analysis of responses was used to assess the levels of adequacy of Landsat 1 and 2 in fulfilling hydrological functions and to derive systems specifications for future water resources-oriented remote sensing satellite systems. The analysis indicated that water resources applications for all but the very large users require: resolutions of order 15 meters; number of radiometric levels of the same order as currently used in LANDSAT 1 (64); number of spectral bands not in excess of those used in LANDSAT 1 (4); and repetition frequency of order 2 weeks. The users had little feel for the value of new sensors: thermal IR, passive and active microwaves. What is needed in this area is to achieve specific demonstrations of the utility of these sensors and submit the results to the users to evince their judgement. All users indicate that the most significant information requirements are in the area of better knowledge of the characteristics of precipitation. Specifically, the temporal behavior (intensity versus time) of rainfall, its areal distribution, the statistics of succession of rain events as a function of time, and the storm travel characteristics. (Sims-ISWS)
W78-01155

7C. Evaluation, Processing and Publication

QUANTITATIVE MAP INTERPRETATION IN REGIONAL PLANNING SURVEYS (IN AFRIKAANS),

Agricultural Research Station, Bethlehem (South Africa).
J. A. Kruger, and J. S. Swart. Proceedings of the Grassland Society of Southern Africa, Vol. 11, p 23-27, 1976. (English summary).

Descriptors: *Maps, Regional analysis, *Surveys, Vegetation, Plant groups.
Identifiers: Eragrostis, Elyonurus, Aristida.

A procedure followed for the quantitative interpretation of maps compiled for regional planning purposes of the Upper Orange catchment-basin is presented. The analyses provided useful figures concerning the distribution of dominant vegetation components and their association with relevant habitat factors. (So. African Water Info. Center)
W78-00934

THE IMPACT OF SECOND-HOME DEVELOPMENT ON WATER AVAILABILITY IN NORTH CENTRAL ARIZONA,

Arizona State Univ., Tempe. Bureau of Business and Economic Research.

For primary bibliographic entry see Field 4C.
W78-01052

A PRELIMINARY APPRAISAL OF THE GARBER-WELLINGTON AQUIFER, SOUTHERN LOGAN AND NORTHERN OKLAHOMA COUNTIES, OKLAHOMA,

Geological Survey, Oklahoma City, OK. Water Resources Div.

J. E. Carr, and M. V. Marcher. Open-file report 77-278, May 1977. 23 p, 11 fig, 2 tab, 11 ref.

Descriptors: *Groundwater resources, *Aquiifer characteristics, *Water yield, *Groundwater recharge, *Water quality, Oklahoma, Sandstones, Groundwater availability, Water supply, Hydrogeology, Saline water-freshwater interfaces, Dissolved solids, Maps.

The Garber-Wellington aquifer in parts of Logan and Oklahoma Counties, Oklahoma, averages about 50 percent sandstone and 50 percent shale. Water-table conditions generally exist in the upper 200 ft in the outcrop area and part of the area overlain by the Hennessey Group. Water containing more than 1,000 mg/liter dissolved solids occurs at various depths throughout the area. The thickness of the freshwater zone ranges from less than 150 ft to about 850 ft. The total amount of water stored in the freshwater zone is estimated to be 21 million acre-ft based on a specific yield of 0.20. Minimum recharge in 1975 is estimated to be 190 acre-ft/sq mi or about 10 percent of the annual precipitation. As a result of pumping, the potentiometric surface in 1975 had been lowered 100 to 200 ft locally. Potential well yields range from 225 to 550 gpm depending on the amount of available drawdown. Upcoming of saline water is a potential threat to water quality in the freshwater zone of the aquifer if the pressure head is excessively lowered, but the problem can be avoided by steady pumping at low rates from widely spaced wells. (Woodard-USGS)
W78-01075

THICKNESS OF THE POTABLE-WATER ZONE IN THE FLORIDAN AQUIFER,

Geological Survey, Jacksonville, FL. Water Resources Div.

For primary bibliographic entry see Field 2F.
W78-01081

NITROGEN LOADS AND CONCENTRATIONS IN FLORIDA STREAMS,

Geological Survey, Tallahassee, FL. Water Resources Div.

L. J. Slack, and D. A. Goolsby. Florida Bureau of Geology Map Series No 75, 1976. 1 sheet, 3 fig, 3 tab, 16 ref.

Descriptors: *Maps, *Nitrogen, *Load distribution, *Florida, *Streams, Path of pollutants, Water quality, Water analysis, Ammonia, Nitrates, Nitrates.

Identifiers: *Solute concentrations, Organic nitrogen.

The data for this map report are based on approximately 4,000 nitrogen analyses from 204 stations on Florida streams. The concentrations of total nitrogen are generally lowest in northwest Florida streams and highest in central and southern Florida. Streams with the highest total nitrogen concentrations are those that receive industrial waste drainage from heavily fertilized areas, or domestic sewage effluent. Organic nitrogen is the dominant species at practically all stations. The average nitrate-nitrogen concentration is less than 1 milligram per liter at 96 percent of the stations. At only 3 percent of the stations is the average nitrite-nitrogen concentration greater than 0.10 milligram per liter. The average ammonia-nitrogen concentration is less than 0.50 milligram per liter at 95 percent of the stations. Concentration of total nitrogen is generally independent of discharge. Total nitrogen load generally varies directly with drainage area. A reasonable order of magnitude estimate for nitrogen yields is 1 ton of nitrogen per square mile per year. Surface waters with nitrogen yields greatly exceeding 1.0 usually receive industrial, municipal, or agricultural effluents. About 21,000 tons of nitrogen are discharged annually through Florida surface waters to the Atlantic and 52,000 tons to the Gulf of Mexico. (Woodard-USGS)
W78-01082

WATER RESOURCES DATA FOR MISSOURI, WATER YEAR 1976,

Geological Survey, Rolla, MO. Water Resources Div.

Water-Data Report MO-76-1, July 1977. 300 p, 3 fig.

Descriptors: *Missouri, *Hydrologic data, *Surface waters, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Water wells, Water levels, Data collections, Sites.

Water resources data for the 1976 water year for Missouri consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water quality of ground water. This report contains discharge records for 127 gaging stations; stage records for 3 of these gaging stations; contents for 6 lakes and reservoirs; and water quality for 19 gaging stations, 11 partial-record stations, 1 lake and 3 wells. Also included are data for 99 crest-stage partial-record stations. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Missouri. (Woodard-USGS)
W78-01083

RECONNAISSANCE OF GROUND-WATER RESOURCES IN A PART OF THE YAMPA RIVER BASIN BETWEEN CRAIG AND STEAMBOAT SPRINGS, MOFFAT AND ROUTT COUNTIES, COLORADO,

Geological Survey, Lakewood, CO. Water Resources Div.

For primary bibliographic entry see Field 2F.
W78-01086

Field 7—RESOURCES DATA

Group 7C—Evaluation, Processing and Publication

MAPS SHOWING GROUND-WATER CONDITIONS IN THE SOUTHERN PART OF THE CHINLE AREA, APACHE COUNTY, ARIZONA-1976.

Geological Survey, Tucson, AZ. Water Resources Div.
G. W. Levings, and C. D. Farrar.
Water-Resources Investigations 77-50 (open-file report), May 1977. 2 sheets, 7 ref.

Descriptors: *Groundwater resources, *Water table, *Water quality, *Maps, Aquifers, Hydrogeology, Arizona.
Identifiers: *Navajo Indian Reservation(Ariz.), *Apache County.

The southern part of the Chinle area includes about 2,100 sq mi in northeastern Arizona and is entirely in the Navajo Indian Reservation. The main source of water is the ground water in the several aquifers that are made up of one or more formations. The aquifers are stacked one on the other and generally are not hydraulically connected. Information on the maps includes depth to water, altitude of the water level, and chemical quality of the water. Scale 1:125,000. (Woodard-USGS)
W78-01087

WATER RESOURCES DATA FOR TENNESSEE, WATER YEAR 1975.

Geological Survey, Nashville, TN. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-254 462, Price codes: A20 in paper copy, A01 in microfiche. Water-Data Report TN-75-1, March 1976. 453 p, 3 fig, 4 tab, 35 ref.

Descriptors: *Tennessee, *Hydrologic data, *Surface waters, *Groundwater, *Water quality, Water resources, Water temperature, Gaging stations, Streamflow, Flow rates, Water wells, Water levels, Lakes, Reservoirs, Sampling, Sites, Water analysis, Chemical analysis, Sediments.

Water resources data for the 1975 water year for Tennessee consist of records of stage, discharge, and water quality of streams and springs; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality of wells. Presented are discharge records for 108 gaging stations; stage only records for 1 lake gaging station; elevation and contents for 26 lakes and reservoirs; water quality for 37 gaging stations, 64 partial-record flow stations, and 31 wells; and water levels for 27 observation wells. Also included are 134 crest-stage partial-record stations and 83 low-flow partial-record stations. Additional water data were collected at various sites, not part of the systematic data collection program, and are published as miscellaneous stream and spring measurements, or as seepage investigations of discharge and water quality. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Tennessee. (Woodard-USGS)
W78-01091

WATER RESOURCES DATA FOR OREGON, WATER YEAR 1976.

Geological Survey, Portland, OR. Water Resources Div.
Water-Data Report OR-76-1, 1977. 592 p, 5 fig, 3 tab.

Descriptors: *Oregon, *Hydrologic data, *Surface waters, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Water wells, Water levels, Data collections, Sites.

Water resources data for the 1976 water year for Oregon consist of records of stage, discharge, and

water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality in wells and springs. This report contains discharge records for 296 gaging stations; stage only records for 8 gaging stations; stage and contents for 42 lakes and reservoirs; water quality for 80 gaging stations, and water levels for 98 observation wells. Also included are 161 crest-stage partial-record stations. Additional water data were collected at various sites, not part of the systematic data collection program, and are published as miscellaneous measurements. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Oregon. (Woodard-USGS)
W78-01092

THE UNITED STATES GEOLOGICAL SURVEY IN ALASKA: ACCOMPLISHMENTS DURING 1976.

Geological Survey, Reston, VA. Geology Div. Circular 751-B, 1977. Blean, K. M., Editor. 112 p, 38 fig, 4 tab, 266 ref.

Descriptors: *Projects, *Alaska, *Hydrology, *Geology, *Publications, Annual, Reviews, Evaluation.
Identifiers: *U.S. Geological Survey projects(Alaska).

United States Geological Survey projects in Alaska include a wide range of topics of economic and scientific interest. Studies in 1976 include economic geology, regional geology, stratigraphy, environmental geology, engineering geology, hydrology, and marine geology. Discussions of the findings or, in some instances, narratives of the course of the investigations are grouped in eight subdivisions corresponding to the six major onshore geographic regions, the offshore projects, and projects that are statewide in scope. Locations of the study areas are shown. In addition, many reports and maps covering various aspects of the geology and mineral and water resources of the State were published. These publications are listed. (Woodard-USGS)
W78-01096

WATER CONSUMPTION BY NUCLEAR POWERPLANTS AND SOME HYDROLOGICAL IMPLICATIONS,

Geological Survey, Reston, VA. Water Resources Div.

E. V. Giusti, and E. L. Meyer. Circular 745, 1977. 14 p, 6 fig, 1 tab, 9 ref.

Descriptors: *Nuclear powerplants, *Water consumption(Except consumptive use), *United States, *Cooling water, Water demand, Projections, Available water, Economic impact, Hydrologic data, Streamflow, Flow rates, Low flow, Surface-groundwater relationships, Evaluation.

Published data show that estimated water consumption varies with the cooling system adopted, being least in once-through cooling (about 18 cubic feet per second per 1,000 megawatts electrical) and greatest in closed cooling with mechanical draft towers (about 30 cubic feet per second per 1,000 megawatts electrical). When freshwater is used at this magnitude, water-resources economy may be affected in a given region. The critical need for cooling water at all times by the nuclear powerplant industry, coupled with the knowledge that water withdrawal in the basin will generally increase with time and will be at a maximum during low-flow periods, indicates a need for reexamination of the design low flow currently adopted and the methods used to estimate it. The amount of power generated, the name of the cooling water source, and the cooling method adopted for all nuclear powerplants projected to be in operation by 1985 in the United States are tabulated and the estimated annual evaporation at each powerplant

site is shown on a map of the conterminous United States. Another map is presented that shows all nuclear powerplants located on river sites as well as stream reaches in the United States where the 7-day, 10-year low flow is at least 300 cubic feet per second or where this amount of flow can be developed with storage. (Woodard-USGS)
W78-01097

8. ENGINEERING WORKS

8A. Structures

WELL REDEVELOPMENT: PART II,

National Water Well Association, Worthington, OH.

For primary bibliographic entry see Field 3B.

W78-00952

GASS ON GAS,

National Water Well Association, Worthington, OH.

For primary bibliographic entry see Field 2F.

W78-00956

OPTIMIZING PENETRATION RATE, PART 1: DETERMINING PARAMETERS THAT AFFECT RATE OF PENETRATION,

Smith International, Inc., Irving. Smooth Tool Div.

J. H. Allen.

Oil and Gas Journal, Vol 75, No 41, p 94-107, October 3, 1977. 5 fig, 2 tab.

Descriptors: *Rotary drilling, *Computer programs, Mathematical models, Bearings, Costs.
Identifiers: Bits.

Outstanding performance can be obtained from present-day journal bearing bits if careful attention is given to the basic factors that affect penetration rate. Contemporary methods for determining the variables that affect rate of penetration should include the use of the latest prediction techniques and programs that provide minimum cost drilling. Moreover, drilling prediction techniques should be modified and updated and new calculation methods developed as new drilling products and new technology are introduced. Despite a considerable technology lag between discovery or development of computer techniques for rotary drilling and field applications of these techniques, many improvements have come about to increase both economy and rate of penetration. Basic factors affecting penetration rate are bit selection, bit weight, bit rotational speed, bit hydraulics, drilling fluid properties, and formation properties. Methods for determining each of these factors are listed in detail with stress on mathematical techniques and computer programs. (See also W78-00960) (Eberle-NWWA)
W78-00959

OPTIMIZING PENETRATION RATE, CONCLUSION: COMPUTER OPTIMIZES OPERATIONS,

Smith International, Inc., Irvine, CA. Smith Tool Div.

J. H. Allen.

Oil and Gas Journal, Vol 75, No 42, p 128-139, October 10, 1977. 4 fig, 35 ref.

Descriptors: *Rotary drilling, *Hydraulics, *Computer programs, Drilling fluids, Mud, Density, Viscosity, Equipment, Geologic formations, Costs.

Identifiers: *Jet bits, Bit weight, Rotary speed, Mud properties, Formation properties, Rate of penetration, Hydraulics programs.

The most significant recent development in improving mud rotary drilling efficiency has been the acceptance and widespread use of jet bits. Research in hydraulics of drilling with these bits

(e.g., ships, hydraulics, rule, program, tests, potential, drilling, NWWA, W78-00957)

EFFECTIVE, PERFORMANCE, WELL, Indian, For primary, W78-00958

NEUTRAL, BORE, BORE, Oil and, For primary, W78-00959

ANCHOR, World, Decades, Descriptions, drains, tions, gy.

Nicholas, general, relations, cm-dia, steel pipe, the sea, water, trench, by 15, trench slab, support, concrete, and p, 8.78 kN, W78-00960

SHIELD, DRIVE, Const. No. 2, Tunnel, Identifi

A mixing, cooling, advanced, Wisconsin, mini, foot, design, planes, of 16, active, s, ing, bonding, full face, two 1, and a, has a, degree, pounds, tions, The co

ENGINEERING WORKS—Field 8

Structures—Group 8A

(e.g., studies of bottom-hole cleaning, relationships between bit weight or rotary speed to hydraulic horsepower, etc.), has helped make calculation of mud properties effective. At present, hydraulics programs can be computed using slide rule calculators, tables or charts, and computer programs. Mud properties considered in such analyses include (1) fluid density, (2) solids content, (3) fluid viscosity, and (4) water loss. Various tests of the formation to be drilled are also essential in estimating penetration rate, bit weight, and drilling costs. (See also W78-00959) (Eberle-NNWA) W78-00960

EFFECTS OF AQUIFER THICKNESS AND SIDE PERFORATION ON DISCHARGE FROM OPEN WELL,

Indian Inst. of Tech., Kharagpur.

For primary bibliographic entry see Field 2F.

W78-00962

NEUTRON LOGGING METHOD FOR LOCATING THE TOP OF CEMENT BEHIND BOREHOLE CASING,

Oil and Natural Gas Commission, Madras (India). For primary bibliographic entry see Field 7B.

W78-00965

ANCHORING A FORCE MAIN IN SAND.

World Construction, Vol. 25, No. 12, p 15, December, 1972. 2 fig.

Descriptors: *Construction, *Sewers, *Storm drains, Pipes, Water table, Timber piles, Foundations, Construction materials, Concrete technology.

Identifiers: Bronx(NY), Raymet.

Nicholas Di Menna and Sons, Incorporated, the general contractor for sewer and storm line installations at Co-op City, Bronx, New York chose 50-cm-diameter, 0.95-cm-wall 'Raymet' spiral-welded steel pipe and fittings for the force main portion of the sewer network. Due to loose fill and a high water table, cross-timber piles driven in the trench to an average depth of 13 meters followed by 15 cm of broken stone ballast placed in the trench as a bed for a 28-cm reinforced concrete slab were used in preparing a firm foundation to support the heavy pipe. Before pouring the concrete cradle, the installed pipe was bulkheaded and pressure tested for 30 minutes with water at 8.78 kg/sq cm. (Sandoski-FIRL) W78-00992

SHIELD-PROTECTED TUNNELING MACHINE DRIVES SEWER UNDER CITY STREETS.

Construction Methods and Equipment, Vol. 55, No. 2, p 99, February, 1973. 2 fig.

Descriptors: *Construction equipment, *Sewers, Tunnels, Tunneling machines, Soils. Identifiers: Milwaukee(Wisc), Mini-John.

A mixed face excavator burrowing through varying conditions of clay, limestone, and hardpan has advanced beneath the streets of Milwaukee, Wisconsin, opening an average of 28 feet of 12-foot, 1.5-inch-diameter sewer tunnel per day. The Mini-John, a 220-hp electro-hydraulic tunneler, is designed to dig both earth and rock with shear planes up to an unconfined compressive strength of 16,000 psi. From within the 19-foot-long protective shield, a toothed-bucket mounted on a rotating boom can be extended seven feet to excavate full face from all levels and angles. Controlled by two 150-ton jacks, the bucket can move 90 degrees and applies a tooth load of 119 tons. The bucket has an 85 degree crowd arc and is rotated 360 degrees by a gear drive that develops 150,000 foot-pounds of torque. A 235-ton hydraulic jack positions the boom radially for fulcircle operations. The conveyor, carrying clay and rock upward and

back at 200 feet a minute, is powered by a 40-hp electro-hydraulic unit. (Sandoski-FIRL) W78-00993

THE EFFECT OF LARGE DAMS ON RIVER WATER TEMPERATURE BELOW THE DAMS, WITH SPECIAL REFERENCE TO BILHARZIA AND THE VERWOERD DAM,

Bilharzia Field Research Unit, Nelspruit (South Africa).

For primary bibliographic entry see Field 6G. W78-00997

1974 ICE BREAKUP ON THE CHENA RIVER,

Cold Regions Research and Engineering Lab., Fairbanks, Alaska. Alaskan Projects Office.

For primary bibliographic entry see Field 2C.

W78-01013

WAIAANE SMALL-BOAT HARBOR, OAHU, HAWAII, DESIGN FOR WAVE PROTECTION, HYDRAULIC MODEL INVESTIGATION,

Army Engineer Waterways Experiment Station, Vicksburg, Miss. Hydraulics Lab.

R. R. Bottin, Jr., C. E. Chatham, Jr., and R. D. Carver.

Available from the National Technical Information Service, Springfield, VA 22161 as AD-A026 134, Price codes: A10 in paper copy, A01 in microfiche. Technical Report H-76-8, May 1976. 199 p, 82 photo, 52 plate, 18 tab, 18 ref, 4 append.

Descriptors: *Waves(Water), *Hawaii, *Hydraulic models, *Harbors, Hydraulics, Shores, Shoreline cover, Model studies, Design.

Identifiers: *Oahu(Hawaii), Harbor design, Stub breakwater, Entrance channel, Turning basin, Breaking waves, Wave protection.

A 1:50-scale (undistorted) hydraulic model, reproducing approximately 1.4 miles of shoreline along the proposed Waianae Small-Boat Harbor site (beginning at Kaneiilo Point and extending northwesterly), the surrounding reef, and sufficient offshore area to permit generation of the required test waves, was used to investigate the arrangement and design of proposed harbor configurations with respect to wave action. The basic harbor configuration consisted of (1) an outer breakwater, (2) a stub breakwater, (3) an entrance channel, turning basin, and main access channel, and (4) revetted fill areas in the harbor interior. Variations to the basic configuration involved changes in the alignments and lengths of the breakwater structure, the cross section of the breakwaters used, the size and shape of the turning basin, the location of fill areas, and the location of the launching ramp inside the harbor. It was concluded from test results of the three-dimensional model that: (1) Existing conditions, plan 1, are characterized by very rough and turbulent waves in the vicinity of the proposed harbor during periods of severe wave attack. (2) For the improvement plans tested, most wave energy reaching the interior of the harbor was due to diffraction through the entrance rather than from overtopping of, or transmission through, the breakwaters. (3) Although several of the improvement plans tested resulted in wave heights within the criteria established by POD (a maximum of 2.5 ft in the turning basin and 2.0 ft in the berthing area), plans 5A and 5C were determined to be the optimum improvement plans considering cost and wave protection afforded. (4) Breaking waves were observed in the entrance channel for some of the more extreme wave conditions, indicating that there will be periods when this channel is not navigable. (5) The harbor appeared to have no adverse effects on wave-induced currents in the immediate area, and wave-induced circulation should aid in harbor flushing. (6) There was no tendency for sediment to deposit either inside the harbor or in the harbor entrance; however, for certain wave conditions, sediment tended to deposit in the navigation channel. This may or may not indicate a

minor potential problem with shoaling of the entrance channel, but shoaling should be no worse than the presently existing at the proposed harbor site. It was concluded from the two-dimensional stability model that, for the range of wave conditions considered, plans 1, 2, and 4 will: (1) Resist significant wave overtopping. (2) Prevent excessive wave energy transmission. (3) Maintain their structural integrity. (Lee-ISWS) W78-01026

STABILITY OF GOBI BLOCK REVETMENT TO WAVE ATTACK,

Coastal Engineering Research Center, Fort Belvoir, VA.

For primary bibliographic entry see Field 8F.

W78-01027

FILLING AND EMPTYING SYSTEM, LITTLE GOOSE LOCK, SNAKE RIVER, WASHINGTON, HYDRAULIC MODEL INVESTIGATION,

Army Engineer Div. North Pacific, Bonneville, OR. Div. Hydraulic Lab.

L. Z. Perkins, and A. J. Chanda.

Available from the National Technical Information Service, Springfield, VA 22161 as AD-A016 791, Price codes: A06 in paper copy, A01 in microfiche. Technical Report No. 115-1, September 1975. 84 p, 26 fig, 19 tab, 1 append.

Descriptors: *Navigation, *Locks, *Hydraulic models, *Vortices, *Tailrace, *Washington, Barges, Hydraulics, Withdrawal, Culverts, Design.

Identifiers: *Little Goose Lock(Wash), Snake River(Wash), *Columbia River(Wash), Manifolds.

Little Goose Lock, located on the Snake River 70 miles above its junction with the Columbia River at Pasco, Washington, is 86 ft wide by 675 ft long and is designed for a maximum lift of 101 ft. The split-level hydraulic system in the lock is unique because both intake manifolds and both longitudinal culverts are in the right wall. This design was expected to reduce construction costs. Owing to the high head, the arrangement of longitudinal culverts, and the unknown hydraulic conditions, model studies of the filling and emptying systems were necessary. The following were to be determined in the model: filling and emptying times, culvert discharges, forces on barge tows moored in the lock chamber, movements of free barge tows, pressures at critical points in the culverts, and the possibility of vortex formation at the intakes. Modifications were done in the prototype design based on the hydraulic model tests. The lock chamber can be filled in 11.3 minutes, and it can be emptied in 12.7 minutes under an initial head of 101 ft without causing average forces greater than 5 tons on 8-barge tow. (Singh-ISWS) W78-01061

COMPARATIVE ASSESSMENT OF WATER USE AND ENVIRONMENTAL IMPLICATIONS OF COAL SLURRY PIPELINES,

Geological Survey, Reston, VA. Water Resources Div.

R. N. Palmer, I. C. James, II, and R. M. Hirsch. Open-file report 77-698, August 1977. 29 p, 9 fig, 1 tab, 17 ref.

Descriptors: *Coals, *Transportation, *Model studies, *Slurries, *Pipelines, Hydraulic transportation, Available water, Economic feasibility, Comparative costs, Railroads, Electric generators, Evaluation.

Identifiers: *Coal-slurry pipelines, *Western United States, Coal gasification-pipeline transport.

With other studies conducted by the U.S. Geological Survey of water use in the conversion and transportation of the West's coal, an analysis of water use and environmental implications of coal-slurry pipeline transport is presented. Simulations

Field 8—ENGINEERING WORKS

Group 8A—Structures

of a hypothetical slurry pipeline of 1000-mile length transporting 12.5 million tons per year indicate that pipeline costs and energy requirements are quite sensitive to the coal-to-water ratio. For realistic water prices, the optimal ratio will not vary far from the 50/50 ratio by weight. In comparison to other methods of energy conversion and transport, coal-slurry pipeline utilize about 1/3 the amount of water required for coal gasification, and about 1/5 the amount required for on-site electrical generation. An analysis of net energy output from operating alternative energy transportation systems for the assumed conditions indicates that both slurry pipeline and rail shipment require approximately 4.5 percent of the potential electrical energy output of the coal transported, and high-voltage, direct-current transportation requires approximately 6.5 percent. The environmental impacts of the different transports options are so substantially different that a common basis for comparison does not exist. (Woodard-USGS) W78-01085

DEPRESSED WEIR WITH TWO UNEQUAL SHEETPILES IN ANISOTROPIC SOIL,
Indian Inst. of Science, Bangalore. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2G.
W78-01151

8B. Hydraulics

TRANSITION FROM SUBLITICAL TO SUPERCRITICAL FLOW,
Technical Univ. of Denmark, Copenhagen. Inst. of Hydrodynamics and Hydraulic Engineering.
V. M. Andersen.
Journal of Hydraulic Research, Vol. 13, No. 3, p 227-238, 1975. 4 fig, 3 ref.

Descriptors: *Transition flow, *Subcritical flow, *Supercritical flow, *Laboratory tests, *Channel flow, Specific head, Flow resistance, Mathematical studies, Flumes, Energy gradient, Slopes, Depth.

A theoretical solution to water surface profile, when there is a sudden change from mild to steep bottom slope, was obtained by neglecting the friction loss in a region about the changing point. The connection of the transition curve to the subcritical curve occurred at a point where the water depth is (rather arbitrarily) a few percent larger than the critical depth, and the connection to the supercritical curve occurred behind the changing point because the total head increases as the water depth is below the critical depth at the point of connection. The slopes of the water surfaces at the connections have to be the same for the two connecting curves. Experimental verification was done using a test flume. The test results were compared with the theoretical results. However, the theoretical expressions did not consider the sidewall effects. The theory and experiments indicated that the critical flow depth occurs on the mild slope side, and the depth at the changing point depends mostly on the value of the steep slope behind the changing point. (Singh-ISWS) W78-00975

GRAVITY WAVES ON A CURRENT: THE INFLUENCE OF VORTICITY, A SLOPING BED, AND DISSIPATION,
Technical Univ. of Denmark, Lyngby. Inst. of Hydrodynamics and Hydraulic Engineering.
For primary bibliographic entry see Field 2E.
W78-01014

ANALYSIS OF A SOLAR COLLECTOR FIELD WATER FLOW NETWORK,
National Aeronautics and Space Administration, Cleveland, OH. Lewis Research Center.
J. E. Rohde, and R. H. Knoll.

Available from the National Technical Information Service, Springfield, VA 22161 as N76-31671, Price codes: A03 in paper copy, A01 in microfiche. Technical Memorandum X-3414, August 1976. 27 p, 15 fig, 3 tab, 3 ref, 1 append.

Descriptors: *Fluid mechanics, *Flow, *Model studies, Mathematical models, Flow control, Flow rates, Flow resistance, Networks, Solar radiation, Engineering.

Identifiers: *Incompressible flow, Solar collector panels, Solar collector fields, Solar collectors, Flow networks, Manifolds.

Methods were presented for minimizing the water flow variation in the solar collector field for the Solar Building Test Facility at the Langley Research Center. The solar collector field investigated consisted of collector panels connected in parallel between inlet and exit collector manifolds to form 12 rows. The rows were, in turn, connected in parallel between the main inlet and exit field manifolds to complete the field. The various solutions considered included various size manifolds, manifold area change, different locations for the inlets and exits to the manifolds, and orifices or flow control valves. Calculations showed that flow variations of less than 5% were obtainable both inside a row between solar collector panels and between various rows. (Sims-ISWS) W78-01032

MARYLAND HIGHWAY DRAINAGE STUDY: VOLUME VIII - A PHYSICAL SIMULATION MODEL OF RUNOFF INTO HIGHWAY CRACKS,
Maryland Univ., College Park. Dept. of Civil Engineering.

J. M. Sinton, and Y. M. Sternberg.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-253 458, Price codes: A10 in paper copy, A01 in microfiche. Final Report AW074-073-046-8, July 1974. 220 p, 36 fig, 14 tab, 42 ref, 2 append. DOT AW074-073-046.

Descriptors: *Highways, *Runoff, *Drainage, *Model studies, Hydraulic models, Simulated rainfall, Laboratory tests, Subsurface drainage, Hydraulics, Data processing, Correlation analysis, Subsurface flow, Discharge(Water), Inflow. Identifiers: *Pavement cracks.

An experimental investigation was conducted concerning the runoff from a simulated highway surface, the interception of runoff by a crack, and flow from a crack into the subbase material of a highway. An artificial rainfall generator supplied flow to the simulated highway surface. Flow into an unrestricted crack (or subbase material) increased for an increased depth of flow, increased crack width, increased rainfall intensity, and roughened crack opening. Flow into an unrestricted crack decreased for increased surface slope and for a smooth crack opening. Statistical evaluation of unrestricted crack data using correlation analysis and factor analysis was presented to show the effect of the rainfall intensity, surface slope, and crack width in the depth of flow and discharge from an unrestricted crack. Prediction equations were obtained for depth of flow and discharge from an unrestricted crack. Flow into a restricted crack (a subbase material restricting flow) was conducted for 3 sample subbase materials: 2 permeable and 1 impermeable. Surface flow into the non-draining (sealed) samples decreased as the sub-base model slope increased. Discharge drained and discharge draining from the samples while rainfall continued increased as the model slope increased. The subbase results indicated that every effort must be made to detect and to evaluate the presence of porous seams and interface flows because they contributed substantially to the flow of water in the model subbase region. (Sims-ISWS) W78-01090

OUTFALL DIFFUSER SYSTEMS -- DESIGN AND INSTALLATION,
Simons (H. A.) International Ltd., Vancouver (British Columbia).
F. J. Shumas.

TAPPI Environmental Conference Papers, Chicago, April 25-27, 1977, (Preprinted Proceedings, TAPPI, Atlanta, Ga.), p 47-65. 8 fig, 2 tab, 9 ref, 3 append.

THREE-DIMENSIONAL SEEPAGE MODEL STUDY OAKLEY DAM, SANGAMON RIVER, ILLINOIS,
Army Engineer Waterways Experiment Station, Vicksburg, MS.

C. L. McAnear, and C. C. Trahan.

Available from the National Technical Information Service, Springfield, VA 22161 as AD-A038 148, Price codes: A03 in paper copy, A01 in microfiche. Miscellaneous Paper S-72-3, January 1972. 24 p, 14 fig.

Descriptors: *Seepage, *Seepage control, *Model studies, *Simulation analysis, *Dams, Uplift pressure, Damsites, Upstream, Downstream, Rivers, Aquifers, Spillways, Computer models, Systems analysis, Hydraulics, Illinois.

Identifiers: *Sangamon River(III), Oakley Dam(III), Subsurface conditions, Soil conditions, *Analog models.

Seepage model studies were conducted for the proposed Oakley damsite using a three-dimensional physical analogy seepage model. Test results indicated that uplift pressures beneath the spillway will vary from 59 percent of the net head at the upstream edge of the structure to 49 percent at the downstream edge. Test results also indicated that piezometric heads at the downstream toe of the dam even with a 1000-ft upstream impervious blanket will be higher than can be safely tolerated. Computed total seepage with the reservoir at flood control pool varied from 2780 gpm (6.2 cfs) to 3290 gpm (7.3 cfs). Seepage control measures such as relief wells and a positive cutoff should be investigated. (Bell-Cornell) W78-01068

SUMMARY OF GEOLOGIC AND HYDROLOGIC INFORMATION PERTINENT TO TUNNELING IN SELECTED URBAN AREAS,
Geological Survey, Reston, VA. Water Resources Div.

E. M. Cushing, and R. M. Barker.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-240 715, Price codes: A16 in paper copy, A01 in microfiche. Department of Transportation Administrative Report, November 1974. 374 p. DOT-AS-40047.

Descriptors: *Stratigraphy, *Hydrogeology, *Tunneling, *Cities, *United States, Water table, Aquifers, Potentiometric level, Geologic mapping, Bedrock, Earth materials, Reviews, Bibliographies, Information retrieval. Identifiers: *Urban areas.

Summaries of geologic and ground-water conditions pertinent to tunneling technology and underground construction to depths of at least 200 feet are given, in tabular form, for 34 large U.S. urban areas. Included are information about engineering soils, bedrock, water-table and artesian aquifers, and special features such as active faults, buried bedrock valleys, expansive clays, and land subsidence, with percentage estimates of the area of occurrence of these conditions. A second part of the summaries shows organizations where geologic and ground-water information can be obtained and the types of information available. A list of sources includes reference to published maps and reports, public and private organizations having pertinent unpublished information, and individuals with expertise on specific subjects. A sketch map shows the area of coverage for each urban center. (Woodard-USGS) W78-01090

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ENGINEERING WORKS—Field 8

Hydraulic Machinery—Group 8C

Descriptors: *Outlets, *Installation, *Design, *Pulp wastes, Hydraulic structures, Outfall sewers, Pulp and paper industry, Waste dilution, Oceans, Rivers, Lakes, Estuaries, Construction materials.

Basic theories are described used in the design of pulp mill outfall and diffuser systems in different receiving environments such as oceans, estuaries, rivers, and lakes. Field test data are given comparing actual dilution with predicted dilution. A review is made of the expected initial dilution of diffuser discharge with respect to the effects of ambient current, trajectory and plume width, discharge density, discharge velocity, discharge port orientation, and depth of discharge below the water surface. Two ocean outfall and diffuser systems are described including materials of construction and methods of installation. (Witt-IPC) W78-00912

UMPQUA RIVER ENTRANCE, OREGON.
Army Engineer District, Vicksburg, MS. Committee on Tidal Hydraulics.

Report, November 1975. 31 p, 1 plate, 11 exhibits, 2 ref, 1 append.

Descriptors: *Rivers, *Estuaries, *Navigation, *Sediment control, *Oregon, Sedimentation, Shoals, Jetties, Dikes, Groins(Structures), Piers, Sand bars, Sand spits, Sediment transport, Shallow water, Coasts, Harbors, Coastal structures, Coastal engineering, Hydraulics.

Identifiers: *Umpqua River(Ore), Training jetties.

The existing Umpqua River entrance project provides for a north jetty 8000 ft long; a south jetty 4200 ft long, terminating 1800 ft south of the seaward end of the north jetty; a training jetty about 5500 ft long, inside the entrance on the south side of the channel; and dredging to secure and maintain an entrance channel 26 ft deep at mean lower low water and of 'suitable' width. The Committee on Tidal Hydraulics was requested to assist in the evaluation of navigation problems at the entrance to the Umpqua River. As a result, the 80th meeting of the Committee was held in Portland on 20-21 May 1975, primarily to discuss and consider these problems. It was clear from the available data that the quantity of littoral drift arriving at the Umpqua entrance from both north and south directions is substantial. The data indicated those annual volumes to be about 500,000 cu yd from the north and 400,000 cu yd from the south. After evaluation of all information and factors available to the Committee at this time, the Committee recommended that the following action be taken if economically justified: (1) The north jetty be rehabilitated to present length. (2) The entrance channel be dredged in a more central location between the jetties and (3) The present training jetty be extended if mitigation of the crosscurrents in the entrance channel area between the jetties is essential to safe vessel operation in that reach of the entrance channel. (Sims-ISWS) W78-01152

8C. Hydraulic Machinery

MINING PUMPS FOR HEADS IN EXCESS OF 1,500 M.
Sulzer Brothers Ltd. (South Africa).
D. S. Came.
The South African Mechanical Engineer, Vol. 27, No. 4, p 107-111, April 1977. 3 fig.

Descriptors: *Mine water, Hydraulic machinery, Dewatering, *Pumps.

Described is probably the first main dewatering pump to deliver against a head in excess of 1,500m installed in a South African gold mine. The pump development and the reasons for the selection of materials used in the construction are discussed together with a brief report on the condition of the

components after 7,000 h operation. A comparison is made between the costs of an installation where pumps deliver 1,800 m in one stage relative to the costs of a relay system where slower speed pumps raise the same quantity of water in two 900 m stages. (So. African Water Info. Center) W78-00930

CAVITATING BIT JETS PROMISE FASTER DRILLING FOR DEEP-HOLE OPERATIONS,
Hydronautics, Inc., Laurel, MD.

A. F. Conn, and R. P. Radtke.
Oil and Gas Journal, Vol 75, No 45, p 129-146, October 31, 1977. 11 fig, 3 tab, 4 ref.

Descriptors: *Cavitation, *Rotary drilling, *Jets, *Nozzles.
Identifiers: *Bits, Kerfing.

Bits which exploit the destructive energy of cavitation are now being tested and developed. The destructive action of cavitation is well known to designers of pumps and hydraulic components, and the cavitating bit is one of the few useful applications of this phenomenon. In contrast to non-cavitating jets, drilling is achieved by the energy from collapsing cavitation bubbles; in materials such as rocks, which are prone to cracking, the extremely localized pressure amplifications from cavitation cause rapid fracturing which greatly enhances erosion. Two series of rock drilling tests have been run with cavitating nozzles, one in which the ambient fluid pressure was atmospheric and one in which ambient pressure was elevated. Rock type, pressure drop, and distance from nozzle to rock face were among the experimental variables. Results show that cavitating jets were much more efficient than standard jets in eroding rock materials. Effects of drilling mud properties have yet to be studied. Prospects for incorporating cavitating jets into diamond-insert or roller-cone types of bits seem promising for the future. (Eberle-NWWA) W78-00957

INSTALLATION, OPERATION AND MAINTENANCE OF VERTICAL TURBINE PUMPS,
International Water Supply Ltd., Montreal (Ontario).

B. Hodgins.
Water and Pollution Control, Vol 115, No 8, p 19-20, August, 1977.

Descriptors: *Pumps, *Pump turbines, Electric motors, Bearings, Failures(Mechanics).

The turbine pump was developed to force water out of a relatively small diameter well with water levels beyond the suction capabilities of a horizontal type pump. There are four basic parts to a turbine pump: driver, pump head, discharge column, and bowl assembly. Lubrication of the line shaft bearings in the column is accomplished by either oil or water, depending upon the pumping situation for which the unit is designed. Vertical turbine pumps are available in a wide range of sizes and shapes, to give various head and capacity combinations at particular speeds, and there is an optimum efficiency point for which maximum discharge and total lift is produced for the minimum driving power for each design. Perfect alignment and a thorough initial testing against manufacturer's specifications are essential for a proper pump installation. Once installed, routine checks of quantity of water produced, hours of motor operation, and water level in the well should be made. Depending on water quality, pumps should be pulled every two to five years and inspected for wear and corrosion. Motor failures are more commonplace than failures in the pump mechanism itself; tinkering with line voltage is more usually the cause than motor manufacturing flaws. (Eberle-NWWA) W78-00961

Described is probably the first main dewatering pump to deliver against a head in excess of 1,500m installed in a South African gold mine. The pump development and the reasons for the selection of materials used in the construction are discussed together with a brief report on the condition of the

UNIQUE BIT DESIGN IMPROVES HYDRAULICS AND PERFORMANCE,
Institut Francaise du Petroles (Grenoble). Div. des Techniques de Forage et de Production.
H. Cholet, G. Baron, R. Lazayres, and J. Brisac.
World Oil, Vol 185, No 5, p 63-65, October, 1977. 6 fig.

Descriptors: *Rotary drilling, *Equipment, *Design, Drill holes, Nozzles, Jets.
Identifiers: *Bits.

A new type of bit developed by ARTEP (Association de Recherche sur les Techniques d'Exploration de Petrole) has shown consistent performance increases of at least 15% over standard roller-cone bits in field tests. This radical design change (in which two nozzles of a three-cone bit are extended and the third directed upward) was made in an effort to improve bottom-hole cleaning. Washing at the mud-rock interface, control of crossflow, fast lifting of cuttings from the bit, and prevention of cutting recycling all are facilitated by the new design. As a result of the more efficient cleaning, both drilling rate and bit life show significant increases, with an overall effect of drilling cost reduction. (Eberle-NWWA) W78-00963

DOWNHOLE DRILLING MOTOR CREATES HIGH TORQUE AT LOW SPEEDS,
Allegheny Ludlum Industries, Inc., Pittsburgh, PA.

W. B. Aufderhaar, and J. F. Melaugh.
Oil and Gas Journal, Vol 75, No 43, p 86-90, October 17, 1977. 6 fig, 13 ref.

Descriptors: *Rotary drilling, Equipment, *Turbines, Deep wells, Bearings.
Identifiers: *Down-hole motors, Garrison Motor-drill.

A new positive-displacement down-hole mud motor offers several advantages over conventional turbines. It produces high torque even at the low rotation rates used with conventional rock bits. The new motor also puts horsepower at the bit more efficiently than conventional drilling, and is not as sensitive to undetected stall-out at high loads. Existing, commercially available mud motors have several deficiencies which include excess rotational speed for tri-cone bits and low capacity of bit weight thrust bearings. Generally, positive-displacement motors are more complex than present-day turbines, requiring broader technology in areas of dynamics, materials, and sealing. Motor speed is proportional to flow rate and fairly constant over the entire load range. Power output and efficiency rise rapidly as load is applied and flatten out to provide a very wide, useful range at relatively high values. The features and test history of the Garrison Motordrill, a newly-developed positive-displacement mud motor, are discussed. (Eberle-NWWA) W78-00964

ELECTRICITY INDEPENDENCE FOR TWO MUNICIPAL SERVICES.
For primary bibliographic entry see Field 5D.
W78-00991

COMPARATIVE ASSESSMENT OF WATER USE AND ENVIRONMENTAL IMPLICATIONS OF COAL SLURRY PIPELINES,
Geological Survey, Reston, VA. Water Resources Div.

For primary bibliographic entry see Field 8A.
W78-01085

Field 8—ENGINEERING WORKS

Group 8D—Soil Mechanics

8D. Soil Mechanics

SOIL SURVEY INTERPRETATIONS FOR EARTH DAMS, Cedar Agricultural Coll., Pietermaritzburg (South Africa). Research Inst. D. M. Scotney, P. J. McPhee, and W. B. Russel. Agricultural Engineering in South Africa, Vol 10, No 1, p 21-29, 1976. 3 fig, 4 tab, 18 ref.

Descriptors: *Soil surveys, Reservoirs, *Earth dams, Embankments, Clay minerals, Dam design, Soil mechanics, Spillways.

Identifiers: South Africa.

There is an urgent need for soil survey interpretations for various purposes in South Africa. Few interpretations for engineering purposes exist and this investigation represents an attempt to interpret soil survey data for earth embankment construction, as well as spillway and basin area suitability for earth dams. Mechanical laboratory soil tests on selected diagnostic materials, defined in terms of the National System of Classification, provided data for an assessment of soil suitability for earth dams. The interpretation is based on soil limitation ratings. Relationships between the clay content of the samples and various engineering properties of soils were established. This interpretation is intended for use by those concerned with the design and construction of small earth dams. (South African Water Info. Center) W78-00938

8E. Rock Mechanics and Geology

SUMMARY OF GEOLOGIC AND HYDROLOGIC INFORMATION PERTINENT TO TUNNELING IN SELECTED URBAN AREAS, Geological Survey, Reston, VA. Water Resources Div. For primary bibliographic entry see Field 8B. W78-01090

8F. Concrete

ANCHORING A FORCE MAIN IN SAND. For primary bibliographic entry see Field 8A. W78-00992

STABILITY OF GOBI BLOCK REVETMENT TO WAVE ATTACK, Coastal Engineering Research Center, Fort Belvoir, VA.

B. L. McCartney, and J. P. Ahrens. Available from the National Technical Information Service, Springfield, VA 22161 as AD-A015 514, Price codes: A02 in paper copy, A01 in microfiche. Technical Memorandum No 55, October 1975. 22 p, 16 fig, 2 tab, 8 ref.

Descriptors: *Retaining walls, *Waves(Water), *Stability, *Louisiana, Beaches, Shores, Riprap, Shore protection, Shoreline cover, Precast concrete, Coastal engineering.

Identifiers: *Gobi blocks, *Holly Beach(La).

Tests of Gobi block revetment stability under wave attack were conducted at prototype scale in large wave tank. Wave heights ranging from 1.6 to 3.2 ft and wave periods from 2.8 to 8.5 sec were used. A 1 on 3.5 embankment slope was tested. Stability of the Gobi block revetment compared favorably with similar weight riprap on the same slope. However, a prototype Gobi block installation at Holly Beach, Louisiana, exhibited greater stability than the wave tank test. This increased stability is attributed to a dry mortar effect of sand and gravel wedged between the blocks. (Sims-ISWS) W78-01027

8G. Materials

WELL REDEVELOPMENT: PART II, National Water Well Association, Worthington, OH. For primary bibliographic entry see Field 3B. W78-00952

CAVITATING BIT JETS PROMISE FASTER DRILLING FOR DEEP-HOLE OPERATIONS, Hydronautics, Inc., Laurel, MD. For primary bibliographic entry see Field 8C. W78-00957

OPTIMIZING PENETRATION RATE, PART 1: DETERMINING PARAMETERS THAT AFFECT RATE OF PENETRATION, Smith International, Inc., Irving. Smith Tool Div. For primary bibliographic entry see Field 8A. W78-00959

OPTIMIZING PENETRATION RATE, CONCLUSION: COMPUTER OPTIMIZES OPERATIONS, Smith International, Inc., Irvine, CA. Smith Tool Div. For primary bibliographic entry see Field 8A. W78-00960

UNIQUE BIT DESIGN IMPROVES HYDRAULICS AND PERFORMANCE, Institut Francaise du Petrole (Grenoble). Div. des Techniques de Forage et de Production. For primary bibliographic entry see Field 8C. W78-00963

DOWNHOLE DRILLING MOTOR CREATES HIGH TORQUE AT LOW SPEEDS, Allegheny Ludlum Industries, Inc., Pittsburgh, PA. For primary bibliographic entry see Field 8C. W78-00964

THE ACTIVITY OF TRACE METALS IN AQUEOUS SYSTEMS AND THE EFFECT OF CORROSION CONTROL INHIBITORS, Albuquerque Univ., NM.

R. Urzendowski, and A. H. Guenther. Available from the National Technical Information Service, Springfield, VA 22161 as AD-A017 611, Price codes: A07 in paper copy, A01 in microfiche. Final Report AFWL-TR-75-203, October 1975. 147 p, 27 fig, 32 tab, 105 ref, 2 append. F29601-73-C-0110.

Descriptors: *Corrosion, *Capacitors, *Inhibitors, *Chemical properties, *Corrosion control, Chemical degradation, Analytical techniques, Inhibition, Oxidation, Electrical equipment, Protective coatings, Trace elements, Water analysis, Water chemistry, Conductivity, Water quality.

Identifiers: *Water capacitors, *Capacitor dielectric systems, Organic additives, Inorganic additives, Electrical characteristics, Dissolved gases in water, Dielectric medium.

The water purification system at Kirtland Air Force Weapons Laboratory was monitored in order to determine the electrical and corrosive characteristics of the water and to investigate its use as a dielectric medium for capacitors. The specific conductance, pH, and the analysis of ionic impurities were used as the basis for evaluating the water purity. From source to use, the water was studied to determine contamination, either ionic or with atmospheric gases such as nitrogen and carbon dioxide. The effect of metallic corrosion in water was studied kinetically in conjunction with equilibrium precipitation of solid phases, chemical implications of impurity removal processes together with various analytical techniques. The principles of metallic corrosion

were broadly surveyed with special reference to the controlling factors of immersion and atmospheric corrosion, as well as their application to the prevention of corrosion under service conditions. Extensive measurements were made on various inorganic, polymeric, and organic additives employed in metallic water systems to study their effectiveness in preventing corrosion. For capacitor dielectric systems for which a low conducting dielectric is needed, organic mixtures were the most satisfactory. (Henley-ISWS) W78-01057

8H. Rapid Excavation

SHIELD-PROTECTED TUNNELING MACHINE DRIVES SEWER UNDER CITY STREETS. For primary bibliographic entry see Field 8A. W78-00993

8I. Fisheries Engineering

USE OF SALT (NaCl) WATER TO REDUCE MORTALITY OF CHINOOK SALMON SMOLTS, ONCORHYNCHUS Tshawytscha, DURING HANDLING AND HAULING, National Marine Fisheries Service, Seattle, WA. Northwest Fisheries Center. For primary bibliographic entry see Field 5G. W78-00909

9. MANPOWER, GRANTS AND FACILITIES

9C. Research Facilities

THE INTERNATIONAL CROPS RESEARCH INSTITUTE FOR THE SEMI-ARID TROPICS, International Crops Research Inst., Hyderabad (India). For primary bibliographic entry see Field 10D. W78-01051

10. SCIENTIFIC AND TECHNICAL INFORMATION

10C. Secondary Publication And Distribution

TOXICITY TO FISH OF CYANIDES AND RELATED COMPOUNDS - A REVIEW, Oregon State Univ., Corvallis. Dept. of Fisheries and Wildlife. For primary bibliographic entry see Field 5C. W78-00927

SANITARY LANDFILLS, A BIBLIOGRAPHY, VOLUME 2, Office of Water Research and Technology, Washington, D.C. For primary bibliographic entry see Field 5E. W78-01004

10D. Specialized Information Center Services

THE INTERNATIONAL CROPS RESEARCH INSTITUTE FOR THE SEMI-ARID TROPICS, International Crops Research Inst., Hyderabad (India). J. W. Spaven. Agricultural Administration, Vol 4, No 1, p 49-55, January, 1977. 5 ref.

Descriptive development, Government Land, Foods,

The International Semi-Arid Tropics Research Group purposes, providing system to improve participation, develops conditions on the diets: ground used, region ICRIS, organization training, W78-01057

THREE UNDERTAKING Oregon For participation

W78-01059

SCIENTIFIC AND TECHNICAL INFORMATION—Field 10

Preparation Of Reviews—Group 10F

Descriptors: *Research facilities, *Research and development, *Semiarid climates, *Crop production, Crops, Water, Agriculture, Technology, Governments, Water resources, Land resources, Land, Sorghum, Grains(Crops), Economics, Foods, Diets, Education, Farms.

The International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) was founded in 1972 as one of the nine international agricultural research groups operating under the Consultative Group of International Agricultural Research. The purpose of ICRISAT is to focus research on improving the principal food crops and farming systems of the semi-arid tropics, identify barriers to improvement, and supply findings to forty-eight participating local government agencies which develop recommendations for farmers. Initial efforts concentrated on India and the semi-arid nations of Africa. Crop improvement efforts focused on the following major food items crucial to local diets: sorghum, millet, pigeon pea, chick pea, and groundnut. Farming systems able to be broadly used, yet appropriate for making optimum use of a region's land and water are emphasized in ICRISAT's farming systems program. The organization also emphasizes short-term, in-service training. (Ullery-Arizona)
W78-01051

10F. Preparation Of Reviews

THRESHOLD OF SEDIMENT MOTION UNDER UNIDIRECTIONAL CURRENTS,
Oregon State Univ., Corvallis. School of Oceanography.
For primary bibliographic entry see Field 02J.
W78-01030

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SUBJECT INDEX

ABANDONED WELLS Impact of Abandoned Wells on Ground Water, W78-00968	6E
ABSORPTION Content and Uptake of Trace Metals in Benthic Algae, Enteromorpha and Porphyra II. Studies on the Algae Cultured in Sea Water Supple- mented with Various Metals, W78-00924	5B
The Influence of Fertilizer-Applied Chlorine, Chlorine Content of Irrigation Water and Leaching of Chlorine on the Uptake of Chlorine By Tobacco (In Afrikaans), W78-00943	3F
ABSTRACTS Sanitary Landfills, A Bibliography, Volume 2, W78-01004	5E
ACID-BASE EQUILIBRIUM The Influence of Ammonia on the Oxygen Delivery System of Coho Salmon Hemoglobin, W78-00916	5C
ACID MINE WATER Feasibility of Elk Creek Acid Mine Drainage Abatement Project, W78-01159	5D
ACTIVATED CARBON Naval Stores Wastewater Purification and Reuse by Activated Carbon Treatment, W78-01160	5D
Pyrolysis of Industrial Wastes for Oil and Ac- tivated Carbon Recovery, W78-01172	5E
Modern Methods of Effluent Treatment, W78-01177	5D
Capital Cost-Saving Service for Textile Ef- fluent Treatment. W78-01178	5D
ACTIVATED SLUDGE Sewage Purification. W78-00996	5D
Results of an NCASI Pilot Plant Study of Mechanical Dewatering Alternatives for Waste Activated Sludge, W78-01123	5D
Effective Textile Industry Effluent Treatment. W78-01175	5D
ADSORPTION Naval Stores Wastewater Purification and Reuse by Activated Carbon Treatment, W78-01160	5D
Capital Cost-Saving Service for Textile Ef- fluent Treatment. W78-01178	5D
The Adsorptive Purification of Effluents with Granular Activated Alumina (Die adsorptive Reinigung von Abwassern mit gekoernter Ak- tivtonerde), W78-01182	5D
AERATION Air Regime of Nonirrigated and Irrigated Caucasian Chernozems, W78-01049	3F
Effective Textile Industry Effluent Treatment. W78-01175	5D
AERIAL PHOTOGRAPHY Analysis of Inhomogeneous Wave Number Spectra, W78-00978	2L
AFRICA Monsoon in Sierra Leone, W78-01145	2B
AIR POLLUTION Meteorological Adjustment of Yearly Mean Values for Air Pollutant Concentration Com- parisons, W78-01153	2B
AIR-WATER INTERFACES Study of Mass Transfer at the Air-Water Inter- face by an Isotopic Method, W78-00977	2D
ALABAMA Water and Related Problems in Coal-Mine Areas of Alabama, W78-01094	5B
ALASKA 1974 Ice Breakup on the Chena River, W78-01013	2C
The United States Geological Survey in Alaska: Accomplishments During 1976. W78-01096	7C
ALGAE Content and Uptake of Trace Metals in Benthic Algae, Enteromorpha and Porphyra I. Measure- ment and Variation of Trace Metal Content of Porphyra Grown in Natural Environment, W78-00908	5B
Content and Uptake of Trace Metals in Benthic Algae, Enteromorpha and Porphyra II. Studies on the Algae Cultured in Sea Water Supple- mented with Various Metals, W78-00924	5B
Algal Bioassays and Nitrogen Fixation, W78-00940	5A
Spectrofluorometric Differentiation of the Red Tide Alga, Gonyaulax Tamarensis from Other Algae Common to New England Waters, W78-00950	5C
ALUMINUM Study of Factors Influencing the Physico- Chemical Purification of Pulp and Paper Indus- try Waste Waters With Aluminum Sulfate (Studiul factorilor care influenteaza epurarea fizico- chimica a apelor reziduale din industria celulozei si hirtiei), W78-00983	5D
Sulphate Removal from Carbonising and Dye- ing Waste Waters. W78-01176	5D
The Adsorptive Purification of Effluents with Granular Activated Alumina (Die adsorptive Reinigung von Abwassern mit gekoernter Ak- tivtonerde), W78-01182	5D
ALUMINUM SULFATE Study of Factors Influencing the Physico- Chemical Purification of Pulp and Paper Indus- try Waste Waters With Aluminum Sulfate (Studiul factorilor care influenteaza epurarea fizico- chimica a apelor reziduale din industria celulozei si hirtiei), W78-00983	5D
AMINO ACIDS Effect of Water Stress on Proline Synthesis from Radioactive Precursors, W78-01042	2I
AMMONIA The Influence of Ammonia on the Oxygen Delivery System of Coho Salmon Hemoglobin, W78-00916	5C
Role of Un-ionized Ammonia in Predisposing Gill Apparatus of <i>Alburnus alburnus</i> alborella to Fungal and Bacterial Diseases, W78-00918	5C
ANALOG MODELS Three-Dimensional Seepage Model Study Oakley Dam, Sangamon River, Illinois, W78-01068	8B
ANALYTICAL TECHNIQUES Effect of Hydrogen Sulfide on Fish and Inver- tebrates Part II-Hydrogen Sulfide Determina- tion and Relationship Between pH and Sulfide Toxicity, W78-00925	5C
Analysis of Inhomogeneous Wave Number Spectra, W78-00978	2L
Multiple Estimates of Lake Erie Evaporation, W78-01035	2D
Sampling of Industrial Wastewater Helps Meet Discharge Standards, W78-01073	7B
Hydrologic Analysis and River-Quality Data Programs, W78-01079	7A
Follow-Up Investigation on Cyanide Complex Detected from Pulp Sludge (Seisi suragi kara kenshutsu sareta shian kagobutsu ni tsuite no tsuiseki chosa), W78-01174	5B
ANESTHETICS Residue Analyses on 2-Amino-4-phenyl- thiazole, a Piscine Anesthetic, in Fishes - III Metabolism in Rainbow Trout and Carp, W78-00923	5A
ANTARCTIC Cenozoic Evolution of Antarctic Glaciation, the Circum-Antarctic Ocean, and Their Impact on Global Paleoceanography, W78-01138	2L
APACHE COUNTY Maps Showing Ground-Water Conditions in the Southern Part of the Chinle Area, Apache County, Arizona-1976, W78-01087	7C
AQUATIC ENVIRONMENT Application of Ecosystem Modeling Methodologies to Dredged Material Research, W78-01070	5A
AQUATIC PLANTS A Quantitative Sampler for Aquatic Macrophytes, W78-00929	7B
Uses of <i>Phragmites Australis</i> (In Afrikaans), W78-00933	4A

SUBJECT INDEX

AQUATIC PLANTS

Some Observed Interrelationships Between the Cover of Aquatic Vegetation and Various Physical Properties of the Water Medium, W78-00941 2I

AQUIFER CHARACTERISTICS

A Preliminary Appraisal of the Garber-Wellington Aquifer, Southern Logan and Northern Oklahoma Counties, Oklahoma, W78-01075 7C

Thickness of the Potable-Water Zone in the Floridan Aquifer, W78-01081 2F

Ground-Water Resources of the Lower Santiam River Basin, Middle Willamette Valley, Oregon, W78-01084 4B

Summary of Ground-Water Conditions in the Jaffna Peninsula, Republic of Sri Lanka, With a Plan for Investigating Feasibility of Ground-Water Development, W78-01093 4B

AQUIFERS

Effects of Aquifer Thickness and Side Perforation on Discharge from Open Well, W78-00962 2F

Electrical Resistivity for Estimating Permeability, W78-01010 2F

Reconnaissance of Ground-Water Resources in a Part of the Yampa River Basin Between Craig and Steamboat Springs, Moffat and Routt Counties, Colorado, W78-01086 2F

Ground-Water Levels and Descriptions of Observation Wells in Idaho, 1975, W78-01089 2F

AREAL DROUGHTS

Area-Deficit-Intensity Characteristics of Droughts, W78-01025 2B

ARIZONA

Draining the Water Projects Out of the Pork Barrel, W78-01045 4A

Hiker Perception of Wilderness: A Study of the Social Carrying Capacity of the Grand Canyon, W78-01047 6B

The Impact of Second-Home Development on Water Availability in North Central Arizona, W78-01052 4C

Mechanisms of Survival of Zoospores of Phytophthora Parasitica in Irrigation Water, W78-01055 3F

ASCORBIMETRY

Ascorbimetric Determination of Oxygen Content in Water (Ascorbinometria metoda oznaczania zawartości tlenu w wodzie), W78-01119 5A

ASSESSMENTS

Report of the United Nations Water Conference, Mar Del Plata, 14-25 March 1977. W78-00972 6E

AVALANCHES

Avalanche Release and Snow Characteristics, San Juan Mountains, Colorado. W78-01062 2C

BACTERIA

Relationships Between the Bivalve Macoma Balthica and Bacteria in Intertidal Sediments: Minas Basin, Bay of Fundy, W78-00905 5C

BANK STABILIZATION

Uses of Phragmites Australis (In Afrikaans), W78-00933 4A

BARK

Toxicity, BOD, and Colour of Effluents from the Kraft Pulping of Bole Wood Containing High Quantities of Bark, W78-01128 5B

BASELINE STUDIES

Water Pollution Investigation: Lower Green Bay and Lower Fox River, W78-01022 5B

BASIC DATA COLLECTIONS

Ground-Water Levels and Descriptions of Observation Wells in Idaho, 1975, W78-01089 2F

BAY OF FUNDY

Relationships Between the Bivalve Macoma Balthica and Bacteria in Intertidal Sediments: Minas Basin, Bay of Fundy, W78-00905 5C

BAYS

Short-Term Transient Variations of Limnological Parameters in Grand Traverse Bay, Lake Michigan, W78-01033 2H

Results from a Numerical Model for Simulating Circulation Patterns and Chlorinity Distributions in Saginaw Bay, W78-01040 2H

BED LOAD

Erosion and Transport of Bed-Load Sediment, W78-01060 2J

BENEFITS

Improved Procedures for Valuation of the Contribution of Recreation to National Economic Development, W78-01003 6B

BENTHIC FAUNA

Relationships Between the Bivalve Macoma Balthica and Bacteria in Intertidal Sediments: Minas Basin, Bay of Fundy, W78-00905 5C

A Plexiglass Subsampling Box for Large Benthos Samples, W78-00913 7B

BENTHIC FLORA

Content and Uptake of Trace Metals in Benthic Algae, Enteromorpha and Porphyra I. Measurement and Variation of Trace Metal Content of Porphyra Grown in Natural Environment, W78-00908 5B

A Plexiglass Subsampling Box for Large Benthos Samples, W78-00913 7B

Content and Uptake of Trace Metals in Benthic Algae, Enteromorpha and Porphyra II. Studies on the Algae Cultured in Sea Water Supplemented with Various Metals, W78-00924 5B

The Use of the Isotope 32P in the Study of Some Ecological Aspects of a Laboratory Stream Ecosystem (In Afrikaans), W78-00945 5A

BENTHOS

A Plexiglass Subsampling Box for Large Benthos Samples, W78-00913 7B

BIBLIOGRAPHIES

Toxicity to Fish of Cyanides and Related Compounds - A Review, W78-00927 5C

Sanitary Landfills, A Bibliography, Volume 2, W78-01004 5E

Eutrophication of Lakes, W78-01020 5C

BIOASSAY

A Saltwater Flow-Through Bioassay Method with Controlled Temperature and Salinity, W78-00917 5A

Acute Toxicity of Four Organophosphorus Insecticides to a Freshwater Teleost Channa Punctatus (Bloch), W78-00919 5C

Algal Bioassays and Nitrogen Fixation, W78-00940 5A

BIOCHEMICAL OXYGEN DEMAND

Bio-Treatment of Effluents with BOD Below 100 MG/Liter, W78-01109 5D

Toxicity, BOD, and Colour of Effluents from the Kraft Pulping of Bole Wood Containing High Quantities of Bark, W78-01128 5B

BIODEGRADATION

Quantitative Studies on Marine Biodegradation of Oil, III. Comparison of Different Crude Oil Residues and Effects of Sea Water Source, W78-00907 5C

BIOINDICATORS

Patella Vulgata: A Biological Monitor of Coastal Metal Pollution - A Preliminary Study, W78-00906 5A

BIOLOGICAL COMMUNITIES

Relationships Between the Bivalve Macoma Balthica and Bacteria in Intertidal Sediments: Minas Basin, Bay of Fundy, W78-00905 5C

BIOLOGICAL PROPERTIES

Limnological Data Report for the Maine Department of Environmental Protection - U.S. Geological Survey Cooperative Lake Studies Project, W78-01078 2H

BIOLOGICAL TREATMENT

Enso-Biox Method - A Biological Method for Purifying Kraft Pulp Mill Condensates, W78-01100 5D

Adjustments and Innovation in a French Paper Mill (Adjustements et innovations dans une papeterie française), W78-01101 5D

Bio-Treatment of Effluents with BOD Below 100 MG/Liter, W78-01109 5D

SUBJECT INDEX

CHEMICAL PRECIPITATION

BIOMASS Phytoplankton, Phytoplankton Growth and Biomass Cycles in an Unpolluted and in a Polluted Polar Lake, W78-00920	5C	Distribution of Organic Matter in Lake Baikal Sediments (Ob osobennostyakh raspredeleniya organichestkogo veshchestva v osadkakh Baikal), W78-00981	2H
BIORHYTHMS Measurement of Periodic Open and Shut Shell Movement of Bivalves by the Strain-Gauge Method, W78-00911	7B	BROOK TROUT Effect of Chronic Exposure of Brook Trout to Sublethal Concentrations of Hydrogen Cyanide, W78-00915	5C
BIOTURBATION Effects of Burrowing Tubificid Worms on the Exchange of Phosphorus Between Lake Sediment and Overlying Water, W78-00921	5C	CADMIUM Content and Uptake of Trace Metals in Benthic Algae, Enteromorpha and Porphyra I. Measurement and Variation of Trace Metal Content of Porphyra Grown in Natural Environment, W78-00908	5B
BITS Cavitating Bit Jets Promise Faster Drilling for Deep-Hole Operations, W78-00957	8C	Content and Uptake of Trace Metals in Benthic Algae, Enteromorpha and Porphyra II. Studies on the Algae Cultured in Sea Water Supplemented with Various Metals, W78-00924	5B
BLEACHING WASTES Effect of Various Technological Factors on the Color of Pulp Mill Effluents (Wpływ różnych czynników technologicznych na barwę ścieków pociąłkowych), W78-00989	5B	CALCIUM CARBONATE Calcium Carbonates in Suspended Deposits of Rivers and Irrigation Systems in Central Asia (In Russian), W78-01072	2J
New In-Plant Technology to Reduce Pollution from a Sodium-Base Sulfite Mill, W78-01104	5D	CALIFORNIA Pacific Sea-Surface Temperature Related to Rain in California, W78-01066	2B
Process Concepts for Oxygen Delignification, W78-01106	5D	The 1976 and 1977 Drought in California: Extent and Severity, W78-01134	2B
Lime Treatment of Bleachery Effluent, W78-01110	5D	CANADA Environmental Impact Assessments for U.S. and Canadian Industries, W78-01099	5C
Studies on Low Molecular Weight Compounds in Kraft Bleaching Liquor (In Japanese), W78-01117	5A	Rainfall Intensity-Frequency Relationships from Monthly Extremes, W78-01149	2B
BLEAK Role of Un-ionized Ammonia in Predisposing Gill Apparatus of <i>Alburnus alburnus</i> alborella to Fungal and Bacterial Diseases, W78-00918	5C	Ice Force Measurements on the Pembina River, Alberta, Canada, W78-01154	2C
BOARD MILLS Disposal and Recycling of Rejects from Waste Paper and Closed Water Systems, W78-01114	3E	CAPACITOR DIELECTRIC SYSTEMS The Activity of Trace Metals in Aqueous Systems and the Effect of Corrosion Control Inhibitors, W78-01057	8G
Utilization of Solids from Waste Water Treatment Plants in Board Manufacture, W78-01115	5D	CAPACITORS The Activity of Trace Metals in Aqueous Systems and the Effect of Corrosion Control Inhibitors, W78-01057	8G
Total Water System (AT) Coshocton Mill (OF) Stone Container Corporation, W78-01124	3E	CARBON DIOXIDE Gass on Gas, W78-00956	2F
BOREHOLE GEOPHYSICS Neutron Logging Method for Locating the Top of Cement Behind Borehole Casing, W78-00965	7B	CARBONATES Patella Vulgata: A Biological Monitor of Coastal Metal Pollution - A Preliminary Study, W78-00906	5A
BOTTOM SEDIMENTS Relationships Between the Bivalve <i>Macoma Balthica</i> and Bacteria in Intertidal Sediments: Minas Basin, Bay of Fundy, W78-00905	5C	CARP Residue Analyses on 2-Amino-4-phenylthiazole, a Piscine Anesthetic, in Fishes - III Metabolism in Rainbow Trout and Carp, W78-00923	5A
CAVITATION Cavitating Bit Jets Promise Faster Drilling for Deep-Hole Operations, W78-00957			
8C			
CEMENT GROUTING Neutron Logging Method for Locating the Top of Cement Behind Borehole Casing, W78-00965			
7B			
CENTRAL ARIZONA PROJECT Draining the Water Projects Out of the Pork Barrel, W78-01045			
4A			
CENTRIFUGATION Mechanical Dewatering of Sediments from Roofing Board Factory Effluents (Optymekanicheskogo obeczvozhivaniya osadkov stochnykh vod kartonno-ruberoidnykh zavodov), W78-01120			
5E			
CEYLON Summary of Ground-Water Conditions in the Jaffna Peninsula, Republic of Sri Lanka, With a Plan for Investigating Feasibility of Ground-Water Development, W78-01093			
4B			
CHANNEL FLOW Transition from Subcritical to Supercritical Flow, W78-00975			
8B			
CHANNEL MORPHOLOGY Possible Effect of Sediments and Channel Processes on Runoff Redistribution in a River Delta, W78-01029			
2J			
CHANNELS Friction Factors for Vegetated Waterways of Small Slope, W78-01031			
2E			
CHEMICAL ANALYSIS Residue Analyses on 2-Amino-4-phenylthiazole, a Piscine Anesthetic, in Fishes - III Metabolism in Rainbow Trout and Carp, W78-00923			
5A			
Analysis of Street Sweepings, Portland, Oregon, W78-01077			
5A			
CHEMICAL BUDGET Hydrologic and Chemical Budgets on Walker Branch Watershed-Observations and Modeling Applications, W78-01071			
2A			
CHEMICAL DEGRADATION Quantitative Studies on Marine Biodegradation of Oil, III. Comparison of Different Crude Oil Residues and Effects of Sea Water Source, W78-00907			
5C			
CHEMICAL PRECIPITATION Study of Factors Influencing the Physico-Chemical Purification of Pulp and Paper Industry Waste Waters With Aluminum Sulfate (Studiu factorilor care influențează epurarea fizico-chimică a apelor reziduale din industria celulozii și hirtiei), W78-00983			
5D			
Chemical Precipitation and Sedimentation of Wallboard Mill Waste Water (Kjemisk felling og sedimentering av wallboardvann), W78-00984			
5D			

SUBJECT INDEX

CHEMICAL PRECIPITATION

Leather Tannery Waste Management Through Process Change, Reuse and Treatment, W78-01156 5D

Sulphate Removal from Carbonising and Dyeing Waste Waters, W78-01176 5D

Modern Methods of Effluent Treatment, W78-01177 5D

The Adsorptive Purification of Effluents with Granular Activated Alumina (Die adsorptive Reinigung von Abwassern mit gekörnter Aktivtontene), W78-01182 5D

CHEMICAL PROPERTIES

The Activity of Trace Metals in Aqueous Systems and the Effect of Corrosion Control Inhibitors, W78-01057 8G

Limnological Data Report for the Maine Department of Environmental Protection -- U.S. Geological Survey Cooperative Lake Studies Project, W78-01078 2H

CHEMICAL REACTIONS

Methylation of Mercury in a Terrestrial Environment, W78-00926 5B

CHEMICAL WASTES

Naval Stores Wastewater Purification and Reuse by Activated Carbon Treatment, W78-01160 5D

CHENA RIVER (ALASKA)

1974 Ice Breakup on the Chena River, W78-01013 2C

CHILE

Advection in the Peru Current as Observed by Satellite, W78-01137 7B

CHINOOK SALMON

Use of Salt (NaCl) Water to Reduce Mortality of Chinook Salmon Smolts, *Oncorhynchus tshawytscha*, During Handling and Hauling, W78-00909 5G

CHLORIDES

Detroit River Flow Characteristic and Their Application to Chemical Loading Estimates, W78-01037 2E

CHLORINATION

Toxicities of 'Excessively' Chlorinated Organic Compounds, W78-00901 5C

Continuous Chlorination of Contaminated Water, W78-00971 5D

Catalytic Waste Treatment Systems for Great Lake Ore Carriers, W78-01157 5D

CHLORINE

Toxicities of 'Excessively' Chlorinated Organic Compounds, W78-00901 5C

The Influence of Fertilizer-Applied Chlorine, Chlorine Content of Irrigation Water and Leaching of Chlorine on the Uptake of Chlorine By Tobacco (In Afrikaans), W78-00943 3F

CHLOROPHYLL

The River Skawa: Water Chemistry and Eutrophication, (In Polish), W78-00990 2K

CHROMATOGRAPHY

Residue Analyses on 2-Amino-4-phenylthiazole, a Piscine Anesthetic, in Fishes -- III Metabolism in Rainbow Trout and Carp, W78-00923 5A

CHROMIUM

Patella Vulgata: A Biological Monitor of Coastal Metal Pollution - A Preliminary Study, W78-00906 5A

Leather Tannery Waste Management Through Process Change, Reuse and Treatment, W78-01156 5D

Innovative Rinse-and-Recovery System for Metal Finishing Processes, W78-01165 5D

Ammonium-Carbonate Leaching of Metal Values from Water-Treatment Sludges, W78-01166 5D

The Origin, Treatment and Disposal of Tannery Effluents, W78-01181 5D

CITIES

Summary of Geologic and Hydrologic Information Pertinent to Tunneling in Selected Urban Areas, W78-01090 8B

CITRUS FRUITS

Cost Comparison of Drip and Flood Irrigation Systems, W78-01048 3F

Mechanisms of Survival of Zoospores of Phytophthora Parasitica in Irrigation Water, W78-01055 3F

CLAMS

Relationships Between the Bivalve *Macoma balthica* and Bacteria in Intertidal Sediments: Minas Basin, Bay of Fundy, W78-00905 5C

CLIMATIC DATA

Late Pleistocene and Recent Climatic Changes in the Egyptian Sahara, W78-01043 2A

CLOSED SYSTEMS

Waste Heat for Evaporation of Effluents, W78-01105 5D

CLOUD MODELS

Computations with the Rand Cloud Model for the Hiplex Workshop, June 1975, W78-01063 2B

CLOUD PHYSICS

Computations with the Rand Cloud Model for the Hiplex Workshop, June 1975, W78-01063 2B

COAL MINE WASTES

Water and Related Problems in Coal-Mine Areas of Alabama, W78-01094 5B

COAL-SLURRY PIPELINES

Comparative Assessment of Water Use and Environmental Implications of Coal Slurry Pipelines, W78-01085 8A

COALS

Treatment System is Innovative for Coal Storage Facility, W78-01074 5D

Comparative Assessment of Water Use and Environmental Implications of Coal Slurry Pipelines, W78-01085 8A

COASTS

A Mechanism for Rip Current Generation on an Open Coast, W78-00976 2L

Mechanics of Suspended Sediment in Random Waves, W78-00980 2L

COLOR

Flocculating Agents Derived from Kraft Lignin, W78-00988 5D

Effect of Various Technological Factors on the Color of Pulp Mill Effluents (Wpływ rożnych czynników technologicznych na barwę ścieków pocięlozowych), W78-00989 5B

Toxicity, BOD, and Colour of Effluents from the Kraft Pulping of Bole Wood Containing High Quantities of Bark, W78-01128 5B

Color Increase of Treated Kraft Mill Effluents, W78-01131 5D

Capital Cost-Saving Service for Textile Effluent Treatment, W78-01178 5D

COLORADO

Computer-Aided Analysis of Skylab Multispectral Scanner Data in Mountainous Terrain for Land Use, Forestry, Water Resource, and Geologic Applications, W78-01059 7B

Avalanche Release and Snow Characteristics, San Juan Mountains, Colorado, W78-01062 2C

COLORADO RIVER BASIN

Draining the Water Projects Out of the Pork Barrel, W78-01045 4A

COLUMBIA RIVER

Use of Salt (NaCl) Water to Reduce Mortality of Chinook Salmon Smolts, *Oncorhynchus tshawytscha*, During Handling and Hauling, W78-00909 5G

COLUMBIA RIVER (WASH)

Filling and Emptying System, Little Goose Lock, Snake River, Washington, Hydraulic Model Investigation, W78-01061 8A

COMBINED SEWERS

Dissolved Air Flotation for Combined Sewer Overflows, W78-00995 5D

COMPUTER MODELS

Hydrologic and Chemical Budgets on Walker Branch Watershed-Observations and Modeling Applications, W78-01071 2A

SUBJECT INDEX

DESERT PLANTS

COMPUTER PROGRAMS

Optimizing Penetration Rate, Part 1: Determining Parameters That Affect Rate of Penetration,
W78-00959 8A

Optimizing Penetration Rate, Conclusion: Computer Optimizes Operations,
W78-00960 8A

CONFERENCES

Report of the United Nations Water Conference, Mar Del Plata, 14-25 March 1977.
W78-00972 6E

CONSTRUCTION

Anchoring a Force Main in Sand.
W78-00992 8A

CONSTRUCTION EQUIPMENT

Shield-Protected Tunneling Machine Drives Sewer Under City Streets.
W78-00993 8A

COOLING WATER

Ecological Aspects of Cooling Water Discharges. (In Swedish),
W78-00922 5C

Water Consumption by Nuclear Powerplants and Some Hydrological Implications,
W78-01097 7C

COPPER

Patella Vulgata: A Biological Monitor of Coastal Metal Pollution - A Preliminary Study,
W78-00906 5A

Content and Uptake of Trace Metals in Benthic Algae, Enteromorpha and Porphyra I. Measurement and Variation of Trace Metal Content of Porphyra Grown in Natural Environment,
W78-00908 5B

Ammonium-Carbonate Leaching of Metal Values from Water-Treatment Sludges,
W78-01166 5D

CORDILLERA VILCANOTA (PERU)

Radiocarbon Dating of the Last Glaciation in Peru,
W78-01009 2C

CORN

Study of the Influence of Soil Drought and High Air Temperature on Some Physiological Processes in Maize Plant (In Serbo-Croatian),
W78-01018 2I

CORN (FIELD)

The Role of Water Nutrition and Yield Level in the Grain-Stalk Ratio of Maize (In Afrikaans),
W78-00946 3F

The Influence of Certain Cultivation Practices on the Growth and Production of Zea Mays in Marginal Areas (In Afrikaans),
W78-00947 3F

The Periods Sensitive to Internal Plant Moisture Stress During Growth and Development of Zea Mays (In Afrikaans),
W78-00948 3F

CORROSION

The Activity of Trace Metals in Aqueous Systems and the Effect of Corrosion Control Inhibitors,
W78-01057 8G

CORROSION CONTROL

The Activity of Trace Metals in Aqueous Systems and the Effect of Corrosion Control Inhibitors,
W78-01057 8G

COST ANALYSIS

Improved Procedures for Valuation of the Contribution of Recreation to National Economic Development,
W78-01003 6B

COST-BENEFIT ANALYSIS

Improved Procedures for Valuation of the Contribution of Recreation to National Economic Development,
W78-01003 6B

COST COMPARISONS

Cost Comparison of Drip and Flood Irrigation Systems,
W78-01048 3F

COSTS

Elimination of Pollution from Cottage Cheese Whey by Drying and Utilization,
W78-01167 5D

State of the Art: Wastewater Management in the Beverage Industry,
W78-01168 5D

CRABS

Egg Mortalities in Wild Populations of the Dungeness Crab in Central and Northern California,
W78-00902 5C

CRAYFISH

Fenitrothion Toxicity to the Freshwater Crayfish, Orconectes limosus,
W78-00904 5C

CREOSOTE BUSH

Rate of Leaf Production and Senescence and Effect of Leaf Age on Net Gas Exchange in Creosotebush,
W78-01054 2I

CROP PRODUCTION

The International Crops Research Institute for the Semi-Arid Tropics,
W78-01051 10D

CROP RESPONSE

The Influence of Certain Cultivation Practices on the Growth and Production of Zea Mays in Marginal Areas (In Afrikaans),
W78-00947 3F

CRUDE OIL RESIDUES

Quantitative Studies on Marine Biodegradation of Oil, III. Comparison of Different Crude Oil Residues and Effects of Sea Water Source,
W78-00907 5C

CUBA

Microbiological Processes in the Meromictic Lake Valle de San Juan in Cuba (In Russian),
W78-01180 2H

CULTIVATED LANDS

Implementation of Field Layout for Mechanization and Surface Water Control,
W78-00942 4A

CURRENTS (WATER)

Direct Measurements of Secondary Currents in River Bends,
W78-01067 2E

Comparison of Model and Observed Currents in Lake Michigan,
W78-01140 2H

CYANATES

Toxicity to Fish of Cyanides and Related Compounds - A Review,
W78-00927 5C

CYANIDE

Effect of Chronic Exposure of Brook Trout to Sublethal Concentrations of Hydrogen Cyanide,
W78-00915 5C

CYANIDES

Toxicity to Fish of Cyanides and Related Compounds - A Review,
W78-00927 5C

DAIRIES

Elimination of Pollution from Cottage Cheese Whey by Drying and Utilization,
W78-01167 5D

DAIRY INDUSTRY

Utilization of Cheese Whey for Wine Production,
W78-01170 5E

DAM DESIGN

The Effect of Large Dams on River Water Temperature Below the Dams, with Special Reference to Bilharzia and the Verwoerd Dam,
W78-00997 6G

DAMS

Three-Dimensional Seepage Model Study Oakley Dam, Sangamon River, Illinois,
W78-01068 8B

DATA COLLECTIONS

Threshold of Sediment Motion Under Unidirectional Currents,
W78-01030 2J

Hydrologic and Chemical Budgets on Walker Branch Watershed-Observations and Modeling Applications,
W78-01071 2A

Hydrologic Analysis and River-Quality Data Programs,
W78-01079 7A

DECAPODS

Temporal Changes in the Plankton of an Industrialized Estuary,
W78-00914 5B

DEINKING MILLS

Disposal and Recycling of Rejects from Waste Paper and Closed Water Systems,
W78-01114 3E

DELIGNIFICATION

Process Concepts for Oxygen Delignification,
W78-01106 5D

DELTA

Possible Effect of Sediments and Channel Processes on Runoff Redistribution in a River Delta,
W78-01029 2J

DESERT PLANTS

Structure of the Epidermal and Subepidermal Cells of Some Desert Plants of Israel, *Anabasis Articulata* and *Calligonum Comosum*,
W78-01053 2I

SUBJECT INDEX

DESERT PLANTS

Rate of Leaf Production and Senescence and Effect of Leaf Age on Net Gas Exchange in Creosotebush, W78-01054 2I

DESERTS

Late Pleistocene and Recent Climatic Changes in the Egyptian Sahara, W78-01043 2A

DESIGN

A Saltwater Flow-Through Bioassay Method with Controlled Temperature and Salinity, W78-00917 5A

Unique Bit Design Improves Hydraulics and Performance, W78-00963 8C

Outfall Diffuser Systems -- Design and Installation, W78-01126 8B

DETROIT RIVER

Detroit River Flow Characteristic and Their Application to Chemical Loading Estimates, W78-01037 2E

DEVELOPING COUNTRIES

Report of the United Nations Water Conference, Mar Del Plata, 14-25 March 1977. W78-00972 6E

DEWATERING

Mechanical Dewatering of Sediments from Roofing Board Factory Effluents (Opyt mehanicheskogo obzozhivaniya osadkov stochnykh vod kartonno-ruberoindnykh zavodov), W78-01120 5E

Results of an NCASI Pilot Plant Study of Mechanical Dewatering Alternatives for Waste Activated Sludge, W78-01123 5D

Start-up and Operating Experience with a Twin Wire Moving Belt Press for Primary Sludge, W78-01129 5D

DIALYSIS

Dialysis for Concentration and Removal of Industrial Wastes, W78-01162 5D

DAZINON

Acute Toxicity of Four Organophosphorus Insecticides to a Freshwater Teleost Channa Punctatus (Bloch), W78-00919 5C

DIMETHOATE

Acute Toxicity of Four Organophosphorus Insecticides to a Freshwater Teleost Channa Punctatus (Bloch), W78-00919 5C

DISCHARGE (WATER)

Effects of Aquifer Thickness and Side Perforation on Discharge from Open Well, W78-00962 2F

DISSOLVED OXYGEN

Dissolved Oxygen and Saturation in an Environment of High Organic Production (Etang De Berre): Role of Halocline on Distribution of These and on the Oxygen-Phosphate Ratio (In French), W78-00935 2L

SUBJECT INDEX

Ascorbimetric Determination of Oxygen Content in Water (Ascorbinometria metoda oznaczania zawartości tlenu w wodzie), W78-01119 5A

DISSOLVED SOLIDS

Calcium Carbonates in Suspended Deposits of Rivers and Irrigation Systems in Central Asia (In Russian), W78-01072 2J

DISTRIBUTION

Content and Uptake of Trace Metals in Benthic Algae, Enteromorpha and Porphyra I. Measurement and Variation of Trace Metal Content of Porphyra Grown in Natural Environment, W78-00908 5B

DISTRIBUTION PATTERNS

Temporal Changes in the Plankton of an Industrialized Estuary, W78-00914 5B

DOMESTIC WASTES

Catalytic Waste Treatment Systems for Great Lake Ore Carriers, W78-01157 5D

DOWN-HOLE MOTORS

Downhole Drilling Motor Creates High Torque at Low Speeds, W78-00964 8C

DRAG

An Analysis of Drag Coefficient at Hurricane Windspeeds from a Numerical Simulation of Dynamical Water Level Changes in Lake Okeechobee, Florida, W78-01023 2H

DRAINAGE

Maryland Highway Drainage Study: Volume VIII - A Physical Simulation Model of Runoff into Highway Cracks, W78-01064 8B

DREDGED MATERIAL

Application of Ecosystem Modeling Methodologies to Dredged Material Research, W78-01070 5A

DRILLING

Water Well Industry Codes and Licensing, W78-00970 6E

DRIP IRRIGATION

Cost Comparison of Drip and Flood Irrigation Systems, W78-01048 3F

DROUGHT

Study of the Influence of Soil Drought and High Air Temperature on Some Physiological Processes in Maize Plant (In Serbo-Croatian), W78-01018 2I

DROUGHT RESISTANCE

Indices of Plant Water Status: Some Comparisons Within and Between Crop Species, W78-01050 2I

DROUGHT TOLERANCE

Indices of Plant Water Status: Some Comparisons Within and Between Crop Species, W78-01050 2I

DROUGHTS

Area-Deficit-Intensity Characteristics of Droughts, W78-01025 2B

The 1976 and 1977 Drought in California: Extent and Severity, W78-01134 2B

DRYING

Elimination of Pollution from Cottage Cheese Whey by Drying and Utilization, W78-01167 5D

DUSTS

Analysis of Street Sweepings, Portland, Oregon, W78-01077 5A

DYES

Capital Cost-Saving Service for Textile Effluent Treatment, W78-01178 5D

DYES

Some Thoughts on Water Conservation and Reuse of Process Liquors, W78-01179 5D

EARTH DAMS

Soil Survey Interpretations for Earth Dams, W78-00938 8D

EAST-CENTRAL OKLAHOMA

Hydrologic Data for the Vamoosa Aquifer, East-Central Oklahoma, W78-01076 2A

EASTERN LAKE SUPERIOR

Sediment Distribution and Bottom Topography of Southeastern Lake Superior, W78-01034 2J

ECOLOGICAL DISTRIBUTION

Temporal Changes in the Plankton of an Industrialized Estuary, W78-00914 5B

ECOLOGY

The Effect of Large Dams on River Water Temperature Below the Dams, with Special Reference to Bilharzia and the Verwoerd Dam, W78-00997 6G

ECONOMICS

Improved Procedures for Valuation of the Contribution of Recreation to National Economic Development, W78-01003 6B

ECOSYSTEMS

Application of Ecosystem Modeling Methodologies to Dredged Material Research, W78-01070 5A

EDDY CELL MODELS

Pollutant Transfer into Water Bodies, W78-01019 5B

EFFLUENTS

Toxicity, BOD, and Colour of Effluents from the Kraft Pulping of Bole Wood Containing High Quantities of Bark, W78-01128 5B

MODERN METHODS OF EFFLUENT TREATMENT

Modern Methods of Effluent Treatment, W78-01177 5D

The Origin, Treatment and Disposal of Tannery Effluents, W78-01181 5D

Egypt

Late Pleistocene and Recent Climatic Changes in the Egyptian Sahara, W78-01043 2A

EL NINHO
Adve...
Satell...
W78-...

ELECTR...
Metal...
Platin...
trode...
W78-...

ELECTR...
New...
troph...
W78-...

EMBRYO...
Egg...
gen...
nia...
W78-...

ENERG...
Energ...
W78-...

ENERG...
Vort...
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W78-...

ENVIR...
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Ecolo...
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ENVIR...
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ENVIR...
Ecolo...
Disc...
W78-...

Lake...
Evalua...
W78-...

ENVIR...
Hiker...
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W78-...

ENVIR...
and C...
W78-...

EPIBIOT...
Egg...
gen...
nia...
W78-...

EPIDEMI...
Fatal...
W78-...

EQUAT...
Obser...
tion t...
W78-...

SUBJECT INDEX

FIBERS (PLANT)

EL NINO	
Advection in the Peru Current as Observed by Satellite, W78-01137	7B
ELECTROLYSIS	
Metal Removal and Cyanide Destruction in Plating Wastewaters Using Particle Bed Electrodes, W78-01173	5D
ELECTROPHORESIS	
New State-of-the-Art Automatic Microelectrophoresis Instrumentation, W78-01132	5A
EMBRYONIC GROWTH STAGE	
Egg Mortalities in Wild Populations of the Dungeness Crab in Central and Northern California, W78-00902	5C
ENERGY	
Energy vs. Environment -- Friends or Foes, W78-01103	5D
Waste Heat for Evaporation of Effluents, W78-01105	5D
ENERGY DISSIPATION	
Vortex Generation by Oscillatory Flow Over Rippled Surfaces, W78-00979	2L
ENVIRONMENT	
Report of the United Nations Water Conference, Mar Del Plata, 14-25 March 1977. W78-00972	6E
Environmental Inventory and Assessment of Navigation Pools 24, 25, and 26, Upper Mississippi and Lower Illinois Rivers; Summary Report, W78-01028	6G
ENVIRONMENTAL EFFECTS	
Ecological Aspects of Cooling Water Discharges. (In Swedish), W78-00922	5C
Environmental Effects of Septic Tank Systems, W78-00967	5B
Lake St. Lucia: Mathematical Modelling and Evaluations of Ameliorative Measures, W78-01006	2H
Hiker Perception of Wilderness: A Study of the Social Carrying Capacity of the Grand Canyon, W78-01047	6B
Environmental Impact Assessments for U.S. and Canadian Industries, W78-01099	5C
EPIBIOTIC FOULING	
Egg Mortalities in Wild Populations of the Dungeness Crab in Central and Northern California, W78-00902	5C
EPIDEMIOLOGY	
Fatal Disease, W78-01021	5C
EQUATIONS	
Observation of Bilinear Systems with Application to Biological Control, W78-01183	5A
EQUIPMENT	
A Plexiglass Subsampling Box for Large Benthos Samples, W78-00913	7B
Unique Bit Design Improves Hydraulics and Performance, W78-00963	8C
Innovative Rinse-and-Recovery System for Metal Finishing Processes, W78-01165	5D
EROSION	
Erosion and Transport of Bed-Load Sediment, W78-01060	2J
ESTIMATING	
Comparison of Different Methods for Estimating Snowcover in Forested, Mountainous Basins Using LANDSAT (ERTS) Images, W78-01095	7B
ESTIMATING EQUATIONS	
Observation of Bilinear Systems with Application to Biological Control, W78-01183	5A
ESTUARIES	
Density-Induced Motions in Shallow Lagoons, W78-00951	2L
Sulfur Content of Sediments of the Marin Estuary and Other Galician Estuaries, (In Spanish), W78-00986	2K
Umpqua River Entrance, Oregon. W78-01152	8B
EUTROPHICATION	
Role of Un-ionized Ammonia in Predisposing Gill Apparatus of <i>Alburnus alburnus</i> alborella to Fungal and Bacterial Diseases, W78-00918	5C
Phytoplankton, Phytoplankton Growth and Biomass Cycles in an Unpolluted and in a Polluted Polar Lake, W78-00920	5C
Algal Bioassays and Nitrogen Fixation, W78-00940	5A
The Use of the Isotope 32P in the Study of Some Ecological Aspects of a Laboratory Stream Ecosystem (In Afrikaans), W78-00945	5A
Eutrophication of Lakes, W78-01020	5C
EVALUATION	
Improved Procedures for Valuation of the Contribution of Recreation to National Economic Development, W78-01003	6B
Hiker Perception of Wilderness: A Study of the Social Carrying Capacity of the Grand Canyon, W78-01047	6B
EVAPORATION	
Study of Mass Transfer at the Air-Water Interface by an Isotopic Method, W78-00977	2D
Multiple Estimates of Lake Erie Evaporation, W78-01035	2D
Waste Heat for Evaporation of Effluents, W78-01105	5D
EVAPOTRANSPIRATION	
Assessment of Dryness and Wetness Based on Precipitation, Water Supply in the Soil and Potential Evapotranspiration (In Serbo-Croatian), W78-01017	2B
EXCESSIVE PRECIPITATION	
Rainfall Intensity-Frequency Relationships from Monthly Extremes, W78-01149	2B
FARM LAGOONS	
State-of-the-Art: Swine Waste Production and Pretreatment Processes, W78-01169	5D
FATHEAD MINNOWS	
Effect of Hydrogen Sulfide on Fish and Invertebrates Part II-Hydrogen Sulfide Determination and Relationship Between pH and Sulfide Toxicity, W78-00925	5C
FEDERAL PROJECT POLICY	
Turning Back the Tides of Long-Time Federal Water Policy, W78-01044	6E
Draining the Water Projects Out of the Pork Barrel, W78-01045	4A
FEDERAL-STATE WATER RIGHTS CONFLICTS	
Turning Back the Tides of Long-Time Federal Water Policy, W78-01044	6E
Draining the Water Projects Out of the Pork Barrel, W78-01045	4A
FEED LOTS	
State-of-the-Art: Swine Waste Production and Pretreatment Processes, W78-01169	5D
FEEDS	
Elimination of Pollution from Cottage Cheese Whey by Drying and Utilization, W78-01167	5D
State of the Art: Wastewater Management in the Beverage Industry, W78-01168	5D
FENITROTHION	
Fenitrothion Toxicity to the Freshwater Crayfish, <i>Orconectes limosus</i> , W78-00904	5C
FERMENTATION	
Utilization of Cheese Whey for Wine Production, W78-01170	5E
FERTILIZATION	
Protection of a Unique Ecological Area Through Improved Water and Fertility Management, W78-01001	2G
FIBERS (PLANT)	
Experiments on the Optimization of Solids Recovery from Excess Recirculated Paper Mill White Water in Sveen-Pedersen Svealls (Incerari de optimizare a procesului de recuperare a materialului din apele re circulante excedentare de la fabricarea hirtiei, la recuperatorul Sveen-Pedersen), W78-00982	5D

SUBJECT INDEX

FIBERS (PLANT)

Instruments for the Detection of Fiber Content in Effluents and for the Classification of Recycled Fibrous Material, W78-01113

5A

FILLERS

Experiments on the Optimization of Solids Recovery from Excess Recirculated Paper Mill White Water in Sveen-Pedersen Savealls (Incerari de optimizare a procesului de recuperare a materialului din apele re circulatice excedentare de la fabricarea hirtiei, la recuperatorul Sveen-Pedersen), W78-00982

5D

FILTRATION

Chemical Agents Used in the Effluent Treatment Plant (Pomocne chemické prostredky v cistme odpadnich vod), W78-00987

5D

Dialysis for Concentration and Removal of Industrial Wastes, W78-01162

5D

FISH BEHAVIOR

Toxicity to Fish of Cyanides and Related Compounds -- A Review, W78-00927

5C

FISH DISEASES

Use of Salt (NaCl) Water to Reduce Mortality of Chinook Salmon Smolts, *Oncorhynchus Tshawytscha*, During Handling and Hauling, W78-00909

5G

Role of Un-ionized Ammonia in Predisposing Gill Apparatus of *Alburnus alburnus* alborella to Fungal and Bacterial Diseases, W78-00918

5C

FISH PHYSIOLOGY

Toxicity to Fish of Cyanides and Related Compounds -- A Review, W78-00927

5C

FLOCCULATION

Chemical Precipitation and Sedimentation of Wallboard Mill Waste Water (Kjemisk felling og sedimentering av wallboardvann), W78-00984

5D

Flocculating Agents Derived from Kraft Lignin, W78-00988

5D

Leather Tannery Waste Management Through Process Change, Reuse and Treatment, W78-01156

5D

Modern Methods of Effluent Treatment, W78-01177

5D

FLOOD IRRIGATION

Cost Comparison of Drip and Flood Irrigations Systems, W78-01048

3F

FLORIDA

An Analysis of Drag Coefficient at Hurricane Windspeeds from a Numerical Simulation of Dynamical Water Level Changes in Lake Okeechobee, Florida, W78-01023

2H

Thickness of the Potable-Water Zone in the Floridan Aquifer, W78-01081

2F

Nitrogen Loads and Concentrations in Florida Streams, W78-01082

7C

A Hydrologic Description of Keystone Lake Near Tampa, Florida, W78-01088

2H

Public Water Supplies of Selected Municipalities in Florida, 1975, W78-01098

6D

FLORIDAN AQUIFER

Thickness of the Potable-Water Zone in the Floridan Aquifer, W78-01081

2F

FLOTATION

Foam Flotation Treatment of Heavy Metals and Fluoride-Bearing Industrial Wastewaters, W78-01164

5D

FLOW

Analysis of a Solar Collector Field Water Flow Network, W78-01032

8B

Detroit River Flow Characteristic and Their Application to Chemical Loading Estimates, W78-01037

2E

Direct Measurements of Secondary Currents in River Bends, W78-01067

2E

FLOW CHARACTERISTICS

Density-Induced Motions in Shallow Lagoons, W78-00951

2L

FLOW CONTROL

The Effect of Large Dams on River Water Temperature Below the Dams, with Special Reference to Bilharzia and the Verwoerd Dam, W78-00997

6G

FLOW MEASUREMENT

Sampling of Industrial Wastewater Helps Meet Discharge Standards, W78-01073

7B

FLOW-THROUGH BIOASSAY

A Saltwater Flow-Through Bioassay Method with Controlled Temperature and Salinity, W78-00917

5A

FLOW UNDER A WEIR

Depressed Weir with Two Unequal Sheetpiles in Anisotropic Soil, W78-01151

2G

FLUID MECHANICS

Analysis of a Solar Collector Field Water Flow Network, W78-01032

8B

FLUORINE

Foam Flotation Treatment of Heavy Metals and Fluoride-Bearing Industrial Wastewaters, W78-01164

5D

FOOD PROCESSING INDUSTRY

State of the Art: Wastewater Management in the Beverage Industry, W78-01168

5D

FORECASTING

Avalanche Release and Snow Characteristics, San Juan Mountains, Colorado, W78-01062

2C

FOREST WATERSHEDS

Regionalization for Forests Based on Their Significance for Water Management (Rajonizace lesu z hlediska jejich vodohospodarskeho vyznamu), W78-01118

lesu z hlediska jejich vodohospodarskeho vyznamu),

W78-01118

3B

FORESTS

Comparison of Different Methods for Estimating Snowcover in Forested, Mountainous Basins Using LANDSAT (ERTS) Images, W78-01095

7B

FOX RIVER (WI)

Water Pollution Investigation: Lower Green Bay and Lower Fox River, W78-01022

5B

FREQUENCY ANALYSIS

Influence of Certain Factors on Rainfall Frequency Values, W78-01144

2B

Rainfall Intensity-Frequency Relationships from Monthly Extremes, W78-01149

2B

FRESHWATER FISH

Effect of Hydrogen Sulfide on Fish and Invertebrates Part II-Hydrogen Sulfide Determination and Relationship Between pH and Sulfide Toxicity, W78-00925

5C

FRICITION

Friction Factors for Vegetated Waterways of Small Slope, W78-01031

2E

FROTH FLOTATION

Foam Flotation Treatment of Heavy Metals and Fluoride-Bearing Industrial Wastewaters, W78-01164

5D

FUELS

Pyrolysis of Industrial Wastes for Oil and Activated Carbon Recovery, W78-01172

5E

FUNGI

Use of Salt (NaCl) Water to Reduce Mortality of Chinook Salmon Smolts, *Oncorhynchus Tshawytscha*, During Handling and Hauling, W78-00909

5G

GASES

Gass on Gas, W78-00956

2F

GAUHATI (INDIA)

A Markov Chain Model for the Occurrences of Dry and Wet Days, W78-01143

2B

GEOLOGY

The United States Geological Survey in Alaska: Accomplishments During 1976, W78-01096

7C

GLACIATION

Radiocarbon Dating of the Last Glaciation in Peru, W78-01009

2C

Cenozoic Evolution of Antarctic Glaciation, the Circum-Antarctic Ocean, and Their Impact on Global Paleoceanography, W78-01138

2L

GLACIERS

Radiocarbon Dating of the Last Glaciation in Peru, W78-01009

2C

SUBJECT INDEX

HUMIC ACIDS

GOBI BLOCKS Stability of Gobi Block Revetment to Wave Attack, W78-01027	8F	WATER RESOURCES Water Resources Data for Missouri, Water Year 1976. W78-01083	7C	HARBORS Waianae Small-Boat Harbor, Oahu, Hawaii, Design for Wave Protection, Hydraulic Model Investigation, W78-01026	8A
GRADIENTS (STREAMS) Density-Induced Motions in Shallow Lagoons, W78-00951	2L	WATER RESOURCES Water Resources Data for Tennessee, Water Year 1975. W78-01091	7C	HAWAII Waianae Small-Boat Harbor, Oahu, Hawaii, Design for Wave Protection, Hydraulic Model Investigation, W78-01026	8A
GRASSED WATERWAYS Friction Factors for Vegetated Waterways of Small Slope, W78-01031	2E	WATER RESOURCES Water Resources Data for Oregon, Water Year 1976. W78-01092	7C	HEAT BALANCE Waste Heat for Evaporation of Effluents, W78-01105	5D
GRAVITY WAVES Gravity Waves on a Current: The Influence of Vorticity, A Sloping Bed, and Dissipation, W78-01014	2E	GROUNDWATER AVAILABILITY The Impact of Second-Home Development on Water Availability in North Central Arizona, W78-01052	4C	HEAT RECOVERY Waste Heat for Evaporation of Effluents, W78-01105	5D
GRAZING The Effect of Seasonal Grazing on the Infiltration Capacity of Soils in a <i>Cymbopogon-Themeda</i> Veld (In Afrikaans), W78-00949	2G	GROUNDWATER RECHARGE Mathematical Modeling of Natural Groundwater Recharge, W78-00974	2F	HEATED WATER Ecological Aspects of Cooling Water Discharges. (In Swedish), W78-00922	5C
GREAT LAKES Multiple Estimates of Lake Erie Evaporation, W78-01035	2D	GROUNDWATER RESOURCES A Preliminary Appraisal of the Garber-Wellington Aquifer, Southern Logan and Northern Oklahoma Counties, Oklahoma, W78-01075	7C	HEAVY METALS Swan Mortality Due to Certain Heavy Metals in the Mission Lake Area, Idaho, W78-00903	5C
Distribution of Water Masses in and Near the Straits of Mackinac, W78-01038	2H	GROUNDWATER RESOURCES Hydrologic Data for the Vamoosa Aquifer, East-Central Oklahoma, W78-01076	2A	PATELLA VULGATA : A Biological Monitor of Coastal Metal Pollution - A Preliminary Study, W78-00906	5A
IFYGL Shipboard Visual Wave Observations vs Wave Measurements, W78-01039	2H	GROUNDWATER RESOURCES Thickness of the Potable-Water Zone in the Floridan Aquifer, W78-01081	2F	Trace Element Concentrations in Marine Organisms from the Cape West Coast, W78-00937	5B
Results from a Numerical Model for Simulating Circulation Patterns and Chlorinity Distributions in Saginaw Bay, W78-01040	2H	GROUNDWATER RESOURCES Ground-Water Resources of the Lower Santiam River Basin, Middle Willamette Valley, Oregon, W78-01084	4B	Foam Flotation Treatment of Heavy Metals and Fluoride-Bearing Industrial Wastewaters, W78-01164	5D
Free Mode Coupling of Saginaw Bay and Lake Huron, W78-01041	2H	GROUNDWATER RESOURCES Reconnaissance of Ground-Water Resources in a Part of the Yampa River Basin Between Craig and Steamboat Springs, Moffat and Routt Counties, Colorado, W78-01086	2F	Metal Removal and Cyanide Destruction in Plating Wastewaters Using Particle Bed Electrodes, W78-01173	5D
The Time-Dependent Response of a Circular Basin of Variable Depth to a Wind Stress, W78-01141	2H	GROUNDWATER RESOURCES Maps Showing Ground-Water Conditions in the Southern Part of the Chinle Area, Apache County, Arizona-1976, W78-01087	7C	HIGH PLAINS REGION Computations with the Rand Cloud Model for the Hiplex Workshop, June 1975, W78-01063	2B
GREEN BAY (WT) Water Pollution Investigation: Lower Green Bay and Lower Fox River, W78-01022	5B	GROUNDWATER RESOURCES Summary of Ground-Water Conditions in the Jaffna Peninsula, Republic of Sri Lanka, With a Plan for Investigating Feasibility of Ground-Water Development, W78-01093	4B	HIGHWAYS Maryland Highway Drainage Study: Volume VIII - A Physical Simulation Model of Runoff into Highway Cracks, W78-01064	8B
GROUNDWATER Removing Iron from a Water Supply, W78-00954	5F	GROUNDWATER RESOURCES Underground Injection Program Set Under Safe Drinking Water Act, W78-00955	6E	HOGS State-of-the-Art: Swine Waste Production and Pretreatment Processes, W78-01169	5D
GROUNDWATER Underground Injection Program Set Under Safe Drinking Water Act, W78-00955	6E	GROUNDWATER RESOURCES Public Water Supplies of Selected Municipalities in Florida, 1975, W78-01098	6D	HOLLY BEACH (LA) Stability of Gobi Block Revetment to Wave Attack, W78-01027	8F
Gass on Gas, W78-00956	2F	GROWTH RATES Phytoplankton, Phytoplankton Growth and Biomass Cycles in an Unpolluted and in a Polluted Polar Lake, W78-00920	5C	HUMAN DISEASES Fatal Disease, W78-01021	5C
Policy Implications of Urban Land Practices for Groundwater Quality, W78-00958	4C	GROWTH RATES Rate of Leaf Production and Senescence and Effect of Leaf Age on Net Gas Exchange in Creosotebush, W78-01054	2I	HUMAN PATHOLOGY Fatal Disease, W78-01021	5C
National Water Commission Views Ground-water Protection, W78-00966	4B	GROWTH STAGES Effect of Chronic Exposure of Brook Trout to Sublethal Concentrations of Hydrogen Cyanide, W78-00915	5C	HUMIC ACIDS The Adsorptive Purification of Effluents with Granular Activated Alumina (Die adsorptive Reinigung von Abwaessern mit gekoernter Aktivtonerde), W78-01182	5D
Impact of Abandoned Wells on Ground Water, W78-00968	6E				
How Recent Federal Legislation has Moved Toward Greater Protection of Groundwater Resources. W78-00969	6E				

SUBJECT INDEX

HYDRAULIC MODELS

HYDRAULIC MODELS
 Waianae Small-Boat Harbor, Oahu, Hawaii, Design for Wave Protection, Hydraulic Model Investigation, W78-01026 8A

Filling and Emptying System, Little Goose Lock, Snake River, Washington, Hydraulic Model Investigation, W78-01061 8A

HYDRAULICS
 Optimizing Penetration Rate, Conclusion: Computer Optimizes Operations, W78-00960 8A

HYDROGEN CYANIDE
 Effect of Chronic Exposure of Brook Trout to Sublethal Concentrations of Hydrogen Cyanide, W78-00915 5C

HYDROGEN ION CONCENTRATION
 The Influence of Ammonia on the Oxygen Delivery System of Coho Salmon Hemoglobin, W78-00916 5C

Effect of Hydrogen Sulfide on Fish and Invertebrates Part II-Hydrogen Sulfide Determination and Relationship Between pH and Sulfide Toxicity, W78-00925 5C

Some Observed Interrelationships Between the Cover of Aquatic Vegetation and Various Physical Properties of the Water Medium, W78-00941 21

HYDROGEN SULFIDE
 Effect of Hydrogen Sulfide on Fish and Invertebrates Part II-Hydrogen Sulfide Determination and Relationship Between pH and Sulfide Toxicity, W78-00925 5C

HYDROGEOLOGY
 Ground-Water Resources of the Lower Santiam River Basin, Middle Willamette Valley, Oregon, W78-01084 4B

Summary of Geologic and Hydrologic Information Pertinent to Tunneling in Selected Urban Areas, W78-01090 8B

HYDROLOGIC BUDGET
 Hydrologic and Chemical Budgets on Walker Branch Watershed-Observations and Modeling Applications, W78-01071 2A

HYDROLOGIC DATA
 Hydrologic Data for the Vamoosa Aquifer, East-Central Oklahoma, W78-01076 2A

Lakes of Oregon: Volume 5. Marion County, W78-01080 2H

Water Resources Data for Missouri, Water Year 1976, W78-01083 7C

A Hydrologic Description of Keystone Lake Near Tampa, Florida, W78-01088 2H

Water Resources Data for Tennessee, Water Year 1975, W78-01091 7C

Water Resources Data for Oregon, Water Year 1976, W78-01092 7C

HYDROLOGY
 The United States Geological Survey in Alaska: Accomplishments During 1976, W78-01096 7C

Regionalization for Forests Based on Their Significance for Water Management (Rajonizace lesu z hlediska jejich vodohospodarskeho vyznamu), W78-01118 3B

ICE
 1974 Ice Breakup on the Chena River, W78-01013 2C

Ice Force Measurements on the Pembina River, Alberta, Canada, W78-01154 2C

ICE BREAKUP
 1974 Ice Breakup on the Chena River, W78-01013 2C

ICE LOADS
 Ice Force Measurements on the Pembina River, Alberta, Canada, W78-01154 2C

IDAHO
 Ground-Water Levels and Descriptions of Observation Wells in Idaho, 1975, W78-01089 2F

ILLINOIS RIVER
 Environmental Inventory and Assessment of Navigation Pools 24, 25, and 26, Upper Mississippi and Lower Illinois Rivers; Summary Report, W78-01028 6G

INCINERATION
 Catalytic Waste Treatment Systems for Great Lake Ore Carriers, W78-01157 5D

INCOMPRESSIBLE FLOW
 Analysis of a Solar Collector Field Water Flow Network, W78-01032 8B

INDIA
 A Markov Chain Model for the Occurrences of Dry and Wet Days, W78-01143 2B

Influence of Certain Factors on Rainfall Frequency Values, W78-01144 2B

Monsoon in Sierra Leone, W78-01145 2B

INDIVIDUAL WATER SYSTEMS
 Ozone: The Water Conditioning Process of the Future Today, W78-00953 5F

Continuous Chlorination of Contaminated Water, W78-00971 5D

INDULIN AT
 Flocculating Agents Derived from Kraft Lignin, W78-00988 5D

INDUSTRIAL WASTES
 State of the Art: Wastewater Management in the Beverage Industry, W78-01168 5D

The Origin, Treatment and Disposal of Tannery Effluents, W78-01181 5D

The Adsorptive Purification of Effluents with Granular Activated Alumina (Die adsorptive Reinigung von Abwassern mit gekoernter Aktivtonerde), W78-01182 5D

INFILTRATION
 The Effect of Seasonal Grazing on the Infiltration Capacity of Soils in a Cymbopogon-Themeda Veld (In Afrikaans), W78-00949 2G

INFLOW
 Reservoir Capacity for Periodic-Stochastic Input and Periodic Output, W78-01012 4A

INHIBITORS
 The Activity of Trace Metals in Aqueous Systems and the Effect of Corrosion Control Inhibitors, W78-01057 8G

INJECTION WELLS
 Underground Injection Program Set Under Safe Drinking Water Act, W78-00955 6E

INSECTICIDES
 Acute Toxicity of Four Organophosphorus Insecticides to a Freshwater Teleost Channa punctatus (Bloch), W78-00919 5C

INSTALLATION
 Outfall Diffuser Systems -- Design and Installation, W78-01126 8B

INSTRUMENTATION
 Measurement of Periodic Open and Shut Shell Movement of Bivalves by the Strain-Gauge Method, W78-00911 7B

Instruments for the Detection of Fiber Content in Effluents and for the Classification of Recycled Fibrous Material, W78-01113 5A

New State-of-the-Art Automatic Microelectrophoresis Instrumentation, W78-01132 5A

Ocean Surface Currents Mapped by Radar, W78-01133 2L

A High-Resolution Electronic Rainfall Intensity Recorder and Totaliser, W78-01142 2B

INTERNATIONAL COOPERATION
 Report of the United Nations Water Conference, Mar Del Plata, 14-25 March 1977, W78-00972 6E

INTERNATIONAL FIELD YEAR FOR THE GREAT LAKES
 IFYGL Shipboard Visual Wave Observations vs Wave Measurements, W78-01039 2H

INTERTIDAL AREAS
 Relationships Between the Bivalve Macoma Balthica and Bacteria in Intertidal Sediments: Minas Basin, Bay of Fundy, W78-00905 5C

SUBJECT INDEX

LANDFILLS

INVESTIGATIONS	
Hydrologic Analysis and River-Quality Data Programs, W78-01079	7A
Lakes of Oregon: Volume 5. Marion County, W78-01080	2H
ION EXCHANGE	
Solute Transfer, with Exchange Between Mobile and Stagnant Water, Through Unsaturated Sand, W78-01065	2G
IRON	
Content and Uptake of Trace Metals in Benthic Algae, Enteromorpha and Porphyra I. Measurement and Variation of Trace Metal Content of Porphyra Grown in Natural Environment, W78-00908	5B
IRON BACTERIA	
Removing Iron from a Water Supply, W78-00954	5F
IRON COMPOUNDS	
Removing Iron from a Water Supply, W78-00954	5F
IRRIGATION EFFECTS	
Air Regime of Nonirrigated and Irrigated Caucasian Chernozems, W78-01049	3F
IRRIGATION EFFICIENCY	
Least Cost Irrigation System Specifications for Various Conditions, W78-00973	3F
IRRIGATION PRACTICE	
Tests on Sprinklers (In Afrikaans), W78-00944	3F
IRRIGATION PRACTICES	
Irrigation of Sugar Cane, W78-00928	3F
IRRIGATION SYSTEMS	
Cost Comparison of Drip and Flood Irrigations Systems, W78-01048	3F
IRRIGATION WATER	
Mechanisms of Survival of Zoospores of Phytophthora Parasita in Irrigation Water, W78-01055	3F
IRRIGATION WELLS	
Effects of Aquifer Thickness and Side Perforation on Discharge from Open Well, W78-00962	2F
ISOTOPE STUDIES	
Study of Mass Transfer at the Air-Water Interface by an Isotopic Method, W78-00977	2D
JET BITS	
Optimizing Penetration Rate, Conclusion: Computer Optimizes Operations, W78-00960	8A
JETS	
Cavitating Bit Jets Promise Faster Drilling for Deep-Hole Operations, W78-00957	8C
KEystone LAKE	
A Hydrologic Description of Keystone Lake Near Tampa, Florida, W78-01088	2H
KRAFT MILLS	
Energy vs. Environment -- Friends or Foes, W78-01103	5D
Process Concepts for Oxygen Delignification, W78-01106	5D
KRAFT PULPING	
Toxicity, BOD, and Colour of Effluents from the Kraft Pulping of Bole Wood Containing High Quantities of Bark, W78-01128	5B
LABORATORY TESTS	
Transition from Subcritical to Supercritical Flow, W78-00975	8B
Water and Chloride Movement Through Soil Columns Simulating Pedal Soils, W78-01011	2G
Threshold of Sediment Motion Under Unidirectional Currents, W78-01030	2J
LAGOONS	
Density-Induced Motions in Shallow Lagoons, W78-00951	2L
LAKE BAIKAL (USSR)	
Distribution of Organic Matter in Lake Baikal Sediments (Ob osobennostyakh raspredeleniya organicheskogo veshchestva v osadkakh Baikala), W78-00981	2H
LAKE BASINS	
A Hydrologic Description of Keystone Lake Near Tampa, Florida, W78-01088	2H
LAKE ERIE	
Multiple Estimates of Lake Erie Evaporation, W78-01035	2D
LAKE HEFNER EQUATIONS	
Multiple Estimates of Lake Erie Evaporation, W78-01035	2D
LAKE HURON	
Distribution of Water Masses in and Near the Straits of Mackinac, W78-01038	2H
Results from a Numerical Model for Simulating Circulation Patterns and Chlorinity Distributions in Saginaw Bay, W78-01040	2H
Free Mode Coupling of Saginaw Bay and Lake Huron, W78-01041	2H
LAKE MICHIGAN	
Short-Term Transient Variations of Limnological Parameters in Grand Traverse Bay, Lake Michigan, W78-01033	2H
Distribution of Water Masses in and Near the Straits of Mackinac, W78-01038	2H
Comparison of Model and Observed Currents in Lake Michigan, W78-01140	2H
LAKE MORPHOLOGY	
A Hydrologic Description of Keystone Lake Near Tampa, Florida, W78-01088	2H
LAKE OKEECHOBEE (FLA)	
An Analysis of Drag Coefficient at Hurricane Windspeeds from a Numerical Simulation of Dynamical Water Level Changes in Lake Okeechobee, Florida, W78-01023	2H
LAKE ONTARIO	
IFYGL Shipboard Visual Wave Observations vs Wave Measurements, W78-01039	2H
The Time-Dependent Response of a Circular Basin of Variable Depth to a Wind Stress, W78-01141	2H
LAKE SEDIMENTS	
Effects of Burrowing Tubificid Worms on the Exchange of Phosphorus Between Lake Sediment and Overlying Water, W78-00921	5C
LAKE STAGES	
A Hydrologic Description of Keystone Lake Near Tampa, Florida, W78-01088	2H
LAKE SUPERIOR	
Sediment Distribution and Bottom Topography of Southeastern Lake Superior, W78-01034	2J
Water Quality Studies of Sixteen Minnesota Rivers Tributary to Lake Superior, W78-01036	5A
LAKES	
Dissolved Oxygen and Saturation in an Environment of High Organic Production (Etang De Berre): Role of Halocline on Distribution of These and on the Oxygen-Phosphate Ratio (In French), W78-00935	2L
Distribution of Organic Matter in Lake Baikal Sediments (Ob osobennostyakh raspredeleniya organicheskogo veshchestva v osadkakh Baikala), W78-00981	2H
Eutrophication of Lakes, W78-01020	5C
An Analysis of Drag Coefficient at Hurricane Windspeeds from a Numerical Simulation of Dynamical Water Level Changes in Lake Okeechobee, Florida, W78-01023	2H
Limnological Data Report for the Maine Department of Environmental Protection -- U.S. Geological Survey Cooperative Lake Studies Project, W78-01078	2H
Lakes of Oregon: Volume 5. Marion County, W78-01080	2H
Effects of Urban Lakes on Surface Runoff and Water Quality, W78-01135	2E
The Time-Dependent Response of a Circular Basin of Variable Depth to a Wind Stress, W78-01141	2H
LANDFILLS	
Sanitary Landfills, A Bibliography, Volume 2, W78-01004	5E

SUBJECT INDEX

LANDSAT

LANDSAT
User Requirements and User Acceptance of Current and Next-Generation Satellite Mission and Sensor Complement, Oriented Toward the Monitoring of Water Resources, W78-01155 7B

LEACHATE
Treatment System is Innovative for Coal Storage Facility, W78-01074 5D

LEACHING
Protection of a Unique Ecological Area Through Improved Water and Fertility Management, W78-01001 2G

LEAD
Swan Mortality Due to Certain Heavy Metals in the Mission Lake Area, Idaho, W78-00903 5C

Content and Uptake of Trace Metals in Benthic Algae, Enteromorpha and Porphyra I. Measurement and Variation of Trace Metal Content of Porphyra Grown in Natural Environment, W78-00908 5B

LEAD POISONING
Swan Mortality Due to Certain Heavy Metals in the Mission Lake Area, Idaho, W78-00903 5C

LEAVES
Effect of Water Stress on Proline Synthesis from Radioactive Precursors, W78-01042 2I

Indices of Plant Water Status: Some Comparisons Within and Between Crop Species, W78-01050 2I

LEGISLATION
The Role of Toxic Compounds in the Revision of the 1983 Effluent Guidelines, W78-01122 6E

LETHAL LIMIT
Fenitrothion Toxicity to the Freshwater Crayfish, *Orconectes limosus*, W78-00904 5C

Toxicity to Fish of Cyanides and Related Compounds -- A Review, W78-00927 5C

LIGNINS
Flocculating Agents Derived from Kraft Lignin, W78-00988 5D

LIME
Study of Factors Influencing the Physico-Chemical Purification of Pulp and Paper Industry Waste Waters With Aluminum Sulfate (Studiul factorilor care influenteaza epurarea fizico- chimica a apelor reziduale din industria celulozei si hirtiei), W78-00983 5D

Lime Treatment of Bleachery Effluent, W78-01110 5D

Sulphate Removal from Carbonising and Dyeing Waste Waters, W78-01176 5D

LIMNOLOGY
Limnological Data Report for the Maine Department of Environmental Protection -- U.S.

Geological Survey Cooperative Lake Studies Project, W78-01078 2H

LIMPET
Patella Vulgata: A Biological Monitor of Coastal Metal Pollution - A Preliminary Study, W78-00906 5A

LINEAR PROGRAMMING
Least Cost Irrigation System Specifications for Various Conditions, W78-00973 3F

LITTLE GOOSE LOCK (WASH)
Filling and Emptying System, Little Goose Lock, Snake River, Washington, Hydraulic Model Investigation, W78-01061 8A

LITTORAL
Relationships Between the Bivalve *Macoma Balthica* and Bacteria in Intertidal Sediments: Minas Basin, Bay of Fundy, W78-00905 5C

LIVESTOCK
State-of-the-Art: Swine Waste Production and Pretreatment Processes, W78-01169 5D

LOAD DISTRIBUTION
Nitrogen Loads and Concentrations in Florida Streams, W78-01082 7C

LOBSTERS
Fenitrothion Toxicity to the Freshwater Crayfish, *Orconectes limosus*, W78-00904 5C

LOCKS
Filling and Emptying System, Little Goose Lock, Snake River, Washington, Hydraulic Model Investigation, W78-01061 8A

LOGGING (RECORDING)
Neutron Logging Method for Locating the Top of Cement Behind Borehole Casing, W78-00956 7B

LOUISIANA
Stability of Gobi Block Revetment to Wave Attack, W78-01027 8F

LOW FLOW
A Study Into the Low-Flow Characteristics of British Rivers, W78-01148 2E

LOWER SANTIAM RIVER BASIN (OREG)
Ground-Water Resources of the Lower Santiam River Basin, Middle Willamette Valley, Oregon, W78-01084 4B

MAINE
Limnological Data Report for the Maine Department of Environmental Protection -- U.S. Geological Survey Cooperative Lake Studies Project, W78-01078 2H

MAINTENANCE
Well Redevelopment: Part II, W78-00952 3B

MALATHION

Acute Toxicity of Four Organophosphorus Insecticides to a Freshwater Teleost *Channa Punctatus* (Bloch), W78-00919 5C

MANGANESE

Content and Uptake of Trace Metals in Benthic Algae, Enteromorpha and Porphyra I. Measurement and Variation of Trace Metal Content of Porphyra Grown in Natural Environment, W78-00908 5B

Content and Uptake of Trace Metals in Benthic Algae, Enteromorpha and Porphyra II. Studies on the Algae Cultured in Sea Water Supplemented with Various Metals, W78-00924 5B

MANNINGS EQUATION

Friction Factors for Vegetated Waterways of Small Slope, W78-01031 2E

MAPS

Quantitative Map Interpretation in Regional Planning Surveys (In Afrikaans), W78-00934 7C

Nitrogen Loads and Concentrations in Florida Streams, W78-01082 7C

Reconnaissance of Ground-Water Resources in a Part of the Yampa River Basin Between Craig and Steamboat Springs, Moffat and Routt Counties, Colorado, W78-01086 2F

Maps Showing Ground-Water Conditions in the Southern Part of the Chinle Area, Apache County, Arizona--1976, W78-01087 7C

MARINE ANIMALS

Recent Evolution of the Different Levels of Marine Pollution of the Soft Substratum Linked with the Big Sewer of Marseille-Corcou (In French), W78-01015 5C

MARINE FISH

Trace Element Concentrations in Marine Organisms from the Cape West Coast, W78-00937 5B

MARION COUNTY LAKES (OREG)

Lakes of Oregon: Volume 5. Marion County, W78-01080 2H

MASS TRANSFER

Study of Mass Transfer at the Air-Water Interface by an Isotopic Method, W78-00977 2D

Pollutant Transfer into Water Bodies, W78-01019 5B

MATHEMATICAL MODELLING

Lake St. Lucia: Mathematical Modelling and Evaluations of Ameliorative Measures, W78-01006 2H

MATHEMATICAL MODELS

Density-Induced Motions in Shallow Lagoons, W78-00951 2L

Mathematical Modeling of Natural Groundwater Recharge, W78-00974 2F

SUBJECT INDEX

MODEL STUDIES

Avalanche Release and Snow Characteristics, San Juan Mountains, Colorado. W78-01062	2C	Reverse Osmosis Field Test: Treatment of Watts Nickel Rinse Waters, W78-01161	5D	MINE WASTES Swan Mortality Due to Certain Heavy Metals in the Mission Lake Area, Idaho, W78-00903	5C
Computations with the Rand Cloud Model for the Hplex Workshop, June 1975, W78-01063	2B	Innovative Rinse-and-Recovery System for Metal Finishing Processes, W78-01165	5D	Water Pollution Caused by Inactive Ore and Mineral Mines - A National Assessment, W78-01158	5B
Application of Ecosystem Modeling Methodologies to Dredged Material Research, W78-01070	5A	Ammonium-Carbonate Leaching of Metal Values from Water-Treatment Sludges, W78-01166	5D		
Comparison of Model and Observed Currents in Lake Michigan, W78-01140	2H	Metal Removal and Cyanide Destruction in Plating Wastewaters Using Particle Bed Electrodes, W78-01173	5D	MINE WATER Mining Pumps for Heads in Excess of 1,500 M, W78-00930	8C
A Markov Chain Model for the Occurrences of Dry and Wet Days, W78-01143	2B			MINERAL OILS Spectrophotometric Determination of Mineral Oils in Water, (In Russian), W78-00912	5A
Observation of Bilinear Systems with Application to Biological Control, W78-01183	5A			MINING Water Pollution Caused by Inactive Ore and Mineral Mines - A National Assessment, W78-01158	5B
MATHEMATICAL STUDIES					
Gravity Waves on a Current: The Influence of Vorticity, A Sloping Bed, and Dissipation, W78-01014	2E			MINNESOTA Water Quality Studies of Sixteen Minnesota Rivers Tributary to Lake Superior, W78-01036	5A
MEAN CRITICAL SHEAR STRESS				MINNOWS Effect of Hydrogen Sulfide on Fish and Invertebrates Part II-Hydrogen Sulfide Determination and Relationship Between pH and Sulfide Toxicity, W78-00925	5C
Erosion and Transport of Bed-Load Sediment, W78-01060	2J			MISSISSIPPI RIVER Environmental Inventory and Assessment of Navigation Pools 24, 25, and 26, Upper Mississippi and Lower Illinois Rivers; Summary Report, W78-01028	6G
MEMBRANE PROCESSES				MISSISSIPPI RIVER BASIN Environmental Inventory and Assessment of Navigation Pools 24, 25, and 26, Upper Mississippi and Lower Illinois Rivers; Summary Report, W78-01028	6G
Reverse Osmosis Field Test: Treatment of Watts Nickel Rinse Waters, W78-01161	5D			MISSOURI Water Resources Data for Missouri, Water Year 1976, W78-01083	7C
Dialysis for Concentration and Removal of Industrial Wastes, W78-01162	5D			MIXING Observed Mixing Lengths in Mountain Streams, W78-01150	2E
Some Thoughts on Water Conservation and Removal of Process Liquors, W78-01179	5D			MIXING LENGTHS Observed Mixing Lengths in Mountain Streams, W78-01150	2E
MERCURY				MIXOLIMNION Microbiological Processes in the Meromictic Lake Valle de San Juan in Cuba (In Russian), W78-01180	2H
Patella Vulgata: A Biological Monitor of Coastal Metal Pollution - A Preliminary Study, W78-00906	5A			MODEL STUDIES Mathematical Modeling of Natural Groundwater Recharge, W78-00974	2F
Methylation of Mercury in a Terrestrial Environment, W78-00926	5B			Reservoir Capacity for Periodic-Stochastic Input and Periodic Output, W78-01012	4A
MEROMICTIC LAKES				Pollutant Transfer into Water Bodies, W78-01019	5B
Microbiological Processes in the Meromictic Lake Valle de San Juan in Cuba (In Russian), W78-01180	2H				
METABOLISM					
Residue Analyses on 2-Amino-4-phenylthiazole, a Piscine Anesthetic, in Fishes - III Metabolism in Rainbow Trout and Carp, W78-00923	5A				
METALS					
Content and Uptake of Trace Metals in Benthic Algae, Enteromorpha and Porphyra I. Measurement and Variation of Trace Metal Content of Porphyra Grown in Natural Environment, W78-00908	5B				
Content and Uptake of Trace Metals in Benthic Algae, Enteromorpha and Porphyra II. Studies on the Algae Cultured in Sea Water Supplemented with Various Metals, W78-00924	5B				
Methylation of Mercury in a Terrestrial Environment, W78-00926	5B				

SUBJECT INDEX

MODEL STUDIES

An Analysis of Drag Coefficient at Hurricane Windspeeds from a Numerical Simulation of Dynamical Water Level Changes in Lake Okeechobee, Florida, W78-01023	2H
Area-Deficit-Intensity Characteristics of Droughts, W78-01025	2B
Analysis of a Solar Collector Field Water Flow Network, W78-01032	8B
Detroit River Flow Characteristic and Their Application to Chemical Loading Estimates, W78-01037	2E
Computations with the Rand Cloud Model for the Hiplex Workshop, June 1975, W78-01063	2B
Maryland Highway Drainage Study: Volume VIII - A Physical Simulation Model of Runoff into Highway Cracks, W78-01064	8B
Three-Dimensional Seepage Model Study Oakley Dam, Sangamon River, Illinois, W78-01068	8B
Comparative Assessment of Water Use and Environmental Implications of Coal Slurry Pipelines, W78-01085	8A
Fitting the Pearson Type 3 Distribution in Practice, W78-01136	2E
Residual Flow and Boundary Shear Stress in the Turbulent Bottom Layer Beneath Waves, W78-01139	2L
Comparison of Model and Observed Currents in Lake Michigan, W78-01140	2H
A Markov Chain Model for the Occurrences of Dry and Wet Days, W78-01143	2B
Simulation of the Inlet Hydrograph for Urban Catchments, W78-01147	2E
Depressed Weir with Two Unequal Sheetpiles in Anisotropic Soil, W78-01151	2G
Meteorological Adjustment of Yearly Mean Values for Air Pollutant Concentration Comparisons, W78-01153	2B
MOFFAT AND ROUTT COUNTIES (COLO)	
Reconnaissance of Ground-Water Resources in a Part of the Yampa River Basin Between Craig and Steamboat Springs, Moffat and Routt Counties, Colorado, W78-01086	2F
MOISTURE	
Indices of Plant Water Status: Some Comparisons Within and Between Crop Species, W78-01050	2I
MOISTURE STRESS	
The Periods Sensitive to Internal Plant Moisture Stress During Growth and Development of Zea Mays (In Afrikaans), W78-00948	3F

Effect of Water Stress on Proline Synthesis from Radioactive Precursors, W78-01042	2I
MOLLUSKS	
Patella Vulgata: A Biological Monitor of Coastal Metal Pollution - A Preliminary Study, W78-00906	5A
Measurement of Periodic Open and Shut Shell Movement of Bivalves by the Strain-Gauge Method, W78-00911	7B
MONITORING	
Patella Vulgata: A Biological Monitor of Coastal Metal Pollution - A Preliminary Study, W78-00906	5A
Sampling of Industrial Wastewater Helps Meet Discharge Standards, W78-01073	7B
MONSOONS	
Monsoon in Sierra Leone, W78-01145	2B
MORTALITY	
Egg Mortalities in Wild Populations of the Dungeness Crab in Central and Northern California, W78-00902	5C
Swan Mortality Due to Certain Heavy Metals in the Mission Lake Area, Idaho, W78-00903	5C
Fenitrothion Toxicity to the Freshwater Crayfish, <i>Orconectes limosus</i> , W78-00904	5C
Use of Salt (NaCl) Water to Reduce Mortality of Chinook Salmon Smolts, <i>Oncorhynchus tshawytscha</i> , During Handling and Hauling, W78-00909	5G
Effect of Chronic Exposure of Brook Trout to Sublethal Concentrations of Hydrogen Cyanide, W78-00915	5C
Role of Un-ionized Ammonia in Predisposing Gill Apparatus of <i>Alburnus alburnus alborella</i> to Fungal and Bacterial Diseases, W78-00918	5C
MOSQUITO FISH	
Toxicities of 'Excessively' Chlorinated Organic Compounds, W78-00901	5C
MOUNTAINS	
Computer-Aided Analysis of Skylab Multispectral Scanner Data in Mountainous Terrain for Land Use, Forestry, Water Resource, and Geologic Applications, W78-01059	7B
Observed Mixing Lengths in Mountain Streams, W78-01150	2E
MULTI-PURPOSE PROJECTS	
Treatment System is Innovative for Coal Storage Facility, W78-01074	5D
MUNICIPAL WASTES	
Physical-Chemical Treatment System at Fitchburg, Massachusetts, W78-01125	5D

MUNICIPAL WATER	
Public Water Supplies of Selected Municipalities in Florida, 1975, W78-01098	6D
MYXOBACTERIA	
Role of Un-ionized Ammonia in Predisposing Gill Apparatus of <i>Alburnus alburnus alborella</i> to Fungal and Bacterial Diseases, W78-00918	5C
NAEGLERIA	
Fatal Disease, W78-01021	5C
NATIONAL ECONOMIC DEVELOPMENT	
Improved Procedures for Valuation of the Contribution of Recreation to National Economic Development, W78-01003	6B
NATIONAL PARKS	
Hiker Perception of Wilderness: A Study of the Social Carrying Capacity of the Grand Canyon, W78-01047	6B
NATIONAL SAFE DRINKING WATER ACT	
Underground Injection Program Set Under Safe Drinking Water Act, W78-00955	6E
NATIONAL WATER COMMISSION	
National Water Commission Views Groundwater Protection, W78-00966	4B
NAVAJO INDIAN RESERVATION (ARIZ)	
Maps Showing Ground-Water Conditions in the Southern Part of the Chinle Area, Apache County, Arizona-1976, W78-01087	7C
NAVIGATION	
Filling and Emptying System, Little Goose Lock, Snake River, Washington, Hydraulic Model Investigation, W78-01061	8A
Umpqua River Entrance, Oregon, W78-01152	8B
NEBRASKA	
Protection of a Unique Ecological Area Through Improved Water and Fertility Management, W78-01001	2G
NEUTRALIZATION	
Feasibility of Elk Creek Acid Mine Drainage Abatement Project, W78-01159	5D
NEUTRON LOGGING	
Neutron Logging Method for Locating the Top of Cement Behind Borehole Casing, W78-00965	7B
NEW ZEALAND	
Observed Mixing Lengths in Mountain Streams, W78-01150	2E
NEWSPRINT MILLS	
Waste Heat for Evaporation of Effluents, W78-01105	5D
NICKEL	
Patella Vulgata: A Biological Monitor of Coastal Metal Pollution - A Preliminary Study, W78-00906	5A

Reverse Osmosis Field Test: Treatment of Watt Nickel Rinse Waters, W78-01161	5D	NUMERICAL ANALYSIS Numerical Modeling of Pollutant Transport Using a Lagrangian Marker Particle Technique, W78-01069	5G
Ammonium-Carbonate Leaching of Metal Values from Water-Treatment Sludges, W78-01166	5D	NUTRIENT REMOVAL Quantitative Studies on Marine Biodegradation of Oil, III. Comparison of Different Crude Oil Residues and Effects of Sea Water Source, W78-00907	5C
NITRATES		NUTRIENT REQUIREMENTS The Role of Water Nutrition and Yield Level in the Grain-Stalk Ratio of Maize (In Afrikaans), W78-00946	3F
Protection of a Unique Ecological Area Through Improved Water and Fertility Management, W78-01001	2G	NUTRIENTS Egg Mortalities in Wild Populations of the Dungeness Crab in Central and Northern California, W78-00902	5C
NITRILES		OAHU (HAWAII) Waianae Small-Boat Harbor, Oahu, Hawaii, Design for Wave Protection, Hydraulic Model Investigation, W78-01026	8A
Protection of a Unique Ecological Area Through Improved Water and Fertility Management, W78-01001	2G	OBSERVATION WELLS Ground-Water Levels and Descriptions of Observation Wells in Idaho, 1975, W78-01089	2F
Nitrogen Loads and Concentrations in Florida Streams, W78-01082	7C	OCEAN CIRCULATION Cenozoic Evolution of Antarctic Glaciation, the Circum-Antarctic Ocean, and Their Impact on Global Paleoceanography, W78-01138	2L
NITROGEN COMPOUNDS		OCEAN CURRENTS Ocean Surface Currents Mapped by Radar, W78-01133	2L
Quantitative Studies on Marine Biodegradation of Oil, III. Comparison of Different Crude Oil Residues and Effects of Sea Water Source, W78-00907	5C	Advection in the Peru Current as Observed by Satellite, W78-01137	7B
Toxicity to Fish of Cyanides and Related Compounds -- A Review, W78-00927	5C	OCEAN WAVES Analysis of Inhomogeneous Wave Number Spectra, W78-00978	2L
Follow-Up Investigation on Cyanide Complex Detected from Pulp Sludge (Seisi suragi kara kenshutsu sareta shian kagobutsu ni tsuite no tsuiseki chosa), W78-01174	5B	OIL Quantitative Studies on Marine Biodegradation of Oil, III. Comparison of Different Crude Oil Residues and Effects of Sea Water Source, W78-00907	5C
NITROGEN FIXATION		OIL POLLUTION Quantitative Studies on Marine Biodegradation of Oil, III. Comparison of Different Crude Oil Residues and Effects of Sea Water Source, W78-00907	5C
Algal Bioassays and Nitrogen Fixation, W78-00940	5A	NON-POINT POLLUTION SOURCES Methods for Identifying and Evaluating the Nature and Extent of Non-point Sources of Pollutants, W78-01024	5B
NON-POINT SOURCES OF POLLUTION Policy Implications of Urban Land Practices for Groundwater Quality, W78-00958	4C	NONCEASING SCOUR Erosion and Transport of Bed-Load Sediment, W78-01060	2J
NOZZLES Cavitation Bit Jets Promise Faster Drilling for Deep-Hole Operations, W78-00957	8C	OIL WASTES Extraction of Chemical Pollutants from Industrial Wastewaters with Volatile Solvents, W78-01171	5D
NUCLEAR POWERPLANTS Water Consumption by Nuclear Powerplants and Some Hydrological Implications, W78-01097	7C	OILS Pyrolysis of Industrial Wastes for Oil and Activated Carbon Recovery, W78-01172	5E
OLIGOTROPHY		OKLAHOMA Hydrologic Data for the Vamoosa Aquifer, East-Central Oklahoma, W78-01076	2A
ON-SITE COLLECTIONS		OLIGOTROPHY Phytoplankton, Phytoplankton Growth and Biomass Cycles in an Unpolluted and in a Polluted Polar Lake, W78-00920	5C
ON-SITE DATA COLLECTIONS		ON-SITE COLLECTIONS Measurement of Periodic Open and Shut Shell Movement of Bivalves by the Strain-Gauge Method, W78-00911	7B
ON-SITE INVESTIGATION		ON-SITE DATA COLLECTIONS A Plexiglass Subsampling Box for Large Benthos Samples, W78-00913	7B
OPEN CHANNELS		ON-SITE INVESTIGATION Content and Uptake of Trace Metals in Benthic Algae, Enteromorpha and Porphyra I. Measurement and Variation of Trace Metal Content of Porphyra Grown in Natural Environment, W78-00908	5B
OREGON		OPEN CHANNELS Gravity Waves on a Current: The Influence of Vorticity, A Sloping Bed, and Dissipation, W78-01014	2E
OCEAN CIRCULATION		OREGON Lakes of Oregon: Volume 5. Marion County, W78-01080	2H
OCEAN CURRENTS		OCEAN CIRCULATION Ground-Water Resources of the Lower Santiam River Basin, Middle Willamette Valley, Oregon, W78-01084	4B
OCEAN WAVES		OCEAN CURRENTS Water Resources Data for Oregon, Water Year 1976, W78-01092	7C
OIL		OCEAN WAVES Comparison of Different Methods for Estimating Snowcover in Forested, Mountainous Basins Using LANDSAT (ERTS) Images, W78-01095	7B
OIL POLLUTION		OCEAN WAVES Umpqua River Entrance, Oregon. W78-01152	8B
ORGANIC COMPOUNDS		OIL POLLUTION Toxicities of 'Excessively' Chlorinated Organic Compounds, W78-00901	5C
ORGANIC MATTER		ORGANIC COMPOUNDS Methylation of Mercury in a Terrestrial Environment, W78-00926	5B
ORGANIC WASTES		ORGANIC MATTER Studies on Low Molecular Weight Compounds in Kraft Bleaching Liquor (In Japanese), W78-01117	5A
ORGANIC WASTES		ORGANIC WASTES Distribution of Organic Matter in Lake Baikal Sediments (Ob osobennostyakh raspredeleniya organicheskogo veshchestva v osadkakh Baikala), W78-00981	2H
ORGANIC WASTES		ORGANIC WASTES Research on the Water Quality of the River Taro from Formova to the Mouth (In Italian), W78-01016	5B
ORGANIC WASTES		ORGANIC WASTES Naval Stores Wastewater Purification and Reuse by Activated Carbon Treatment, W78-01160	5D
ORGANIC WASTES		ORGANIC WASTES The Adsorptive Purification of Effluents with Granular Activated Alumina (Die adsorptive	5D

SUBJECT INDEX

ORGANIC WASTES

Reinigung von Abwaessern mit gekoernter Aktivtonerde,	5D
W78-01182	
ORGANOPHOSPHOROUS PESTICIDES	
Fenitrothion Toxicity to the Freshwater Crayfish, <i>Orconectes limosus</i> ,	5C
W78-00904	
Acute Toxicity of Four Organophosphorus Insecticides to a Freshwater Teleost <i>Channa punctatus</i> (Bloch),	5C
W78-00919	
OSCILLATORY FLOW	
Vortex Generation by Oscillatory Flow Over Rippled Surfaces,	2L
W78-00979	
OUTLETS	
Outfall Diffuser Systems -- Design and Installation,	8B
W78-01126	
OXIDATION	
Quantitative Studies on Marine Biodegradation of Oil, III. Comparison of Different Crude Oil Residues and Effects of Sea Water Source,	5C
W78-00907	
OXIDATION LAGOONS	
Microbial Self-Purification by the Lagoon Method, (In French),	5D
W78-00910	
State-of-the-Art: Sewage Waste Production and Pretreatment Processes,	5D
W78-01169	
Effective Textile Industry Effluent Treatment.	5D
W78-01175	
OXYGEN	
The Influence of Ammonia on the Oxygen Delivery System of Coho Salmon Hemoglobin,	5C
W78-00916	
Process Concepts for Oxygen Delignification,	5D
W78-01106	
OXYGEN DEMAND	
Quantitative Studies on Marine Biodegradation of Oil, III. Comparison of Different Crude Oil Residues and Effects of Sea Water Source,	5C
W78-00907	
OXYGEN REQUIREMENTS	
The Influence of Ammonia on the Oxygen Delivery System of Coho Salmon Hemoglobin,	5C
W78-00916	
OZONE	
Ozone: The Water Conditioning Process of the Future Today,	5F
W78-00953	
PACIFIC OCEAN	
Pacific Sea-Surface Temperature Related to Rain in California,	2B
W78-01066	
Advection in the Peru Current as Observed by Satellite,	7B
W78-01137	
PALEOCEANOGRAPHY	
Cenozoic Evolution of Antarctic Glaciation, the Circum-Antarctic Ocean, and Their Impact on Global Paleoceanography,	2L
W78-01138	

PALEOCLIMATOLOGY	
Late Pleistocene and Recent Climatic Changes in the Egyptian Sahara,	2A
W78-01043	
PARATHION	
Acute Toxicity of Four Organophosphorus Insecticides to a Freshwater Teleost <i>Channa punctatus</i> (Bloch),	5C
W78-00919	
PATH OF POLLUTANTS	
Toxicity to Fish of Cyanides and Related Compounds -- A Review,	5C
W78-00927	
Sanitary Landfills, A Bibliography, Volume 2.	5E
W78-01004	
Pollutant Transfer into Water Bodies,	5B
W78-01019	
PATHOGENIC BACTERIA	
Role of Un-ionized Ammonia in Predisposing Gill Apparatus of <i>Alburnus alburnus alburnus</i> to Fungal and Bacterial Diseases,	5C
W78-00918	
PATHOGENIC FUNGI	
Use of Salt (NaCl) Water to Reduce Mortality of Chinook Salmon Smolts, <i>Oncorhynchus tshawytscha</i> , During Handling and Hauling,	5G
W78-00909	
Role of Un-ionized Ammonia in Predisposing Gill Apparatus of <i>Alburnus alburnus alburnus</i> to Fungal and Bacterial Diseases,	5C
W78-00918	
PAVEMENT CRACKS	
Maryland Highway Drainage Study: Volume VIII - A Physical Simulation Model of Runoff into Highway Cracks,	8B
W78-01064	
PEARSON TYPE 3 DISTRIBUTION	
Fitting the Pearson Type 3 Distribution in Practice,	2E
W78-01136	
PEMBINA RIVER (ALBERTA)	
Ice Force Measurements on the Pembina River, Alberta, Canada,	2C
W78-01154	
PERIODIC-STOCHASTIC INPUT	
Reservoir Capacity for Periodic-Stochastic Input and Periodic Output,	4A
W78-01012	
PERMEABILITY	
The Effect of Seasonal Grazing on the Infiltration Capacity of Soils in a <i>Cymbopogon-Themedea</i> Veld (In Afrikaans),	2G
W78-00949	
PERU	
Radiocarbon Dating of the Last Glaciation in Peru,	2C
W78-01009	
PESTICIDE KINETICS	
Fenitrothion Toxicity to the Freshwater Crayfish, <i>Orconectes limosus</i> ,	5C
W78-00904	

PESTICIDE TOXICITY	
Fenitrothion Toxicity to the Freshwater Crayfish, <i>Orconectes limosus</i> ,	5C
W78-00904	
PHOSPHORUS	
Effects of Burrowing Tubificid Worms on the Exchange of Phosphorus Between Lake Sediment and Overlying Water,	5C
W78-00921	
PHOSPHORUS RADIOISOTOPES	
The Use of the Isotope ^{32}P in the Study of Some Ecological Aspects of a Laboratory Stream Ecosystem (In Afrikaans),	5A
W78-00945	
PHOTOSYNTHESIS	
Rate of Leaf Production and Senescence and Effect of Leaf Age on Net Gas Exchange in Creosotebush,	2I
W78-01054	
PHYSICAL MODELS	
Application of Ecosystem Modeling Methodologies to Dredged Material Research,	5A
W78-01070	
PHYTOPHTHORA PARASITICA	
Mechanisms of Survival of Zoospores of Phytophtthora Parasitica in Irrigation Water,	3F
W78-01055	
PHYTOPLANKTON	
Temporal Changes in the Plankton of an Industrialized Estuary,	5B
W78-00914	
Phytoplankton, Phytoplankton Growth and Biomass Cycles in an Unpolluted and in a Polluted Polar Lake,	5C
W78-00920	
Contribution to the Phytoplankton of the Bakanske Rameno, A Tributary of the Danube River (In Czech),	5C
W78-01116	
PIPELINES	
Comparative Assessment of Water Use and Environmental Implications of Coal Slurry Pipelines,	8A
W78-01085	
PLANKTON	
Temporal Changes in the Plankton of an Industrialized Estuary,	5B
W78-00914	
PLANT MORPHOLOGY	
Structure of the Epidermal and Subepidermal Cells of Some Desert Plants of Israel, <i>Anabasis articulata</i> and <i>Calligonum comosum</i> ,	2I
W78-01053	
PLANT PHYSIOLOGY	
Rate of Leaf Production and Senescence and Effect of Leaf Age on Net Gas Exchange in Creosotebush,	2I
W78-01054	
PLANT TISSUES	
Structure of the Epidermal and Subepidermal Cells of Some Desert Plants of Israel, <i>Anabasis articulata</i> and <i>Calligonum comosum</i> ,	2I
W78-01053	
POLLUTANT IDENTIFICATION	
Residue Analyses on 2-Amino-4-phenylthiazole, a Piscine Anesthetic, in Fishes -- III Metabolism in Rainbow Trout and Carp,	5A
W78-00923	

SUBJECT INDEX

PULP WASTES

Studies on Low Molecular Weight Compounds in Kraft Bleaching Liquor (In Japanese), W78-01117	5A	czynników technologicznych na barwe ściekow pocelulozowych), W78-00989	5B
Detoxification of Bleached Kraft Mill Effluents -- A Manageable Problem, W78-01127	5D	Environmental Impact Assessments for U.S. and Canadian Industries, W78-01099	5C
POLLUTANTS		Enso-Biox Method -- A Biological Method for Purifying Kraft Pulp Mill Condensates, W78-01100	5D
Methods for Identifying and Evaluating the Nature and Extent of Non-point Sources of Pollutants. W78-01024	5B	Adjustments and Innovation in a French Paper Mill (Adjustements et innovations dans une papeterie française), W78-01101	5D
Meteorological Adjustment of Yearly Mean Values for Air Pollutant Concentration Comparisons, W78-01153	2B	Analysis and Characterization of Suspended Solids in Pulp and Paper Mill Effluent, W78-01102	5A
POLLUTION ABATEMENT		New In-Plant Technology to Reduce Pollution from a Sodium-Base Sulfite Mill, W78-01104	5D
Considerations and Possibilities of Optimizing the Water Circuits of the Braila Pulp and Paper Mill (Consideratii si posibilitati privind optimizarea circuitelor apelor de fabricatie la C.C.H.-Braila), W78-00985	3E	Waste Heat for Evaporation of Effluents, W78-01105	5D
New In-Plant Technology to Reduce Pollution from a Sodium-Base Sulfite Mill, W78-01104	5D	Effluent Quality Improvement in a Bleached Kraft Pulp Mill, W78-01107	5D
Closing up Kraft Mill Systems -- Reduction of Effluents and Control of Material Balances, W78-01108	3E	Bio-Treatment of Effluents with BOD Below 100 MG/Liter, W78-01109	5D
POROSITY		Treatment of Pulp and Paper Mill Effluents Using Physical-Chemical Techniques, W78-01111	5D
The Effect of Seasonal Grazing on the Infiltration Capacity of Soils in a Cymbopogon-Themed Veld (In Afrikaans), W78-00949	2G	Separation and Reuse of Waste Solids from Liquid Effluents, W78-01112	5D
PORTLAND (OREG)		Instruments for the Detection of Fiber Content in Effluents and for the Classification of Recycled Fibrous Material, W78-01113	5A
Analysis of Street Sweepings, Portland, Oregon, W78-01077	5A	Utilization of Solids from Waste Water Treatment Plants in Board Manufacture, W78-01115	5D
POTABLE WATER		Treatment Plant for Effluent from the Albruck Paper Mill, W78-01121	5D
Thickness of the Potable-Water Zone in the Floridan Aquifer, W78-01081	2F	The Role of Toxic Compounds in the Revision of the 1983 Effluent Guidelines, W78-01122	6E
POTABLE-WATER ZONE THICKNESS		Results of an NCASI Pilot Plant Study of Mechanical Dewatering Alternatives for Waste Activated Sludge, W78-01123	5D
Thickness of the Potable-Water Zone in the Floridan Aquifer, W78-01081	2F	Physical-Chemical Treatment System at Fitchburg, Massachusetts, W78-01125	5D
PRIMARY AMOEBOIC MENIGOENCEPHALITIS (PAME)		Outfall Diffuser Systems -- Design and Installation, W78-01126	8B
Fatal Disease, W78-01021	5C	Detoxification of Bleached Kraft Mill Effluents -- A Manageable Problem, W78-01127	5D
PROBABLE MAXIMUM PRECIPITATION		Toxicity, BOD, and Colour of Effluents from the Kraft Pulping of Bole Wood Containing High Quantities of Bark, W78-01128	5B
Influence of Certain Factors on Rainfall Frequency Values, W78-01144	2B		
PROFILES			
The Interrelationships of the Longitudinal Profiles and Channel Pattern for the Red River, W78-01146	2E		
PROJECTS			
The United States Geological Survey in Alaska: Accomplishments During 1976. W78-01096	7C		
PROLINE			
Effect of Water Stress on Proline Synthesis from Radioactive Precursors, W78-01042	2I		
PUBLIC HEALTH			
Relationships Between the Bivalve Macoma Balthica and Bacteria in Intertidal Sediments: Minas Basin, Bay of Fundy, W78-00905	5C		
Fatal Disease, W78-01021	5C		
PUBLICATIONS			
The United States Geological Survey in Alaska: Accomplishments During 1976. W78-01096	7C		
PULP AND PAPER INDUSTRY			
Considerations and Possibilities of Optimizing the Water Circuits of the Braila Pulp and Paper Mill (Consideratii si posibilitati privind optimizarea circuitelor apelor de fabricatie la C.C.H.-Braila), W78-00985	3E		
Energy vs. Environment -- Friends or Foes, W78-01103	5D		
Closing up Kraft Mill Systems -- Reduction of Effluents and Control of Material Balances, W78-01108	3E		
Disposal and Recycling of Rejects from Waste Paper and Closed Water Systems, W78-01114	3E		
Total Water System (AT) Coshocton Mill (OF) Stone Container Corporation, W78-01124	3E		
Pyrolysis of Industrial Wastes for Oil and Activated Carbon Recovery, W78-01172	5E		
Follow-Up Investigation on Cyanide Complex Detected from Pulp Sludge (Seisi suragi kara kenshutsu sareta shian kagobutsu ni tsuite no tsuiseki chosa), W78-01174	5B		
PULP WASTES			
Experiments on the Optimization of Solids Recovery from Excess Recirculated Paper Mill White Water in Sveen-Pedersen Savealls (Incercari de optimizare a procesului de recuperare a materialului din apele re circulante excedentare de la fabricarea hirtiei, la recuperatorul Sveen-Pedersen), W78-00982	5D		
Study of Factors Influencing the Physico-Chemical Purification of Pulp and Paper Industry Waste Waters With Aluminum Sulfate (Studiu factorilor care influenteaza epurarea fizico- chimica a apelor reziduale din industria celulozei si hirtiei), W78-00983	5D		
Chemical Precipitation and Sedimentation of Wallboard Mill Waste Water (Kjemisk felling og sedimentering av wallboardvann), W78-00984	5D		
Chemical Agents Used in the Effluent Treatment Plant (Pomoce chemicke prostredky v cistirne odpadnicich vod), W78-00987	5D		
Flocculating Agents Derived from Kraft Lignin, W78-00988	5D		
Effect of Various Technological Factors on the Color of Pulp Mill Effluents (Wplyw roznych czynnikow technologicznych na barwe ściekow pocelulozowych), W78-00989	5B		

SUBJECT INDEX

PULP WASTES

Start-up and Operating Experience with a Twin Wire Moving Belt Press for Primary Sludge, W78-01129	5D	RAINFALL	Solar Activity and Rainfall Variation Over Southern Africa, W78-00939	2B	RED TIDE	Spectrofluorometric Differentiation of the Red Tide Alga, Gonioaulax Tamarensis from Other Algae Common to New England Waters, W78-00950	5C
Water Quality Protection at the (Simpson Paper Company) Shasta Mill, W78-01130	5D		Pacific Sea-Surface Temperature Related to Rain in California, W78-01066	2B	REGULATION	Impact of Abandoned Wells on Ground Water, W78-00968	6E
Color Increase of Treated Kraft Mill Effluents, W78-01131	5D		A Markov Chain Model for the Occurrences of Dry and Wet Days, W78-01143	2B	REHABILITATION	Well Redevelopment: Part II, W78-00952	3B
Follow-Up Investigation on Cyanide Complex Detected from Pulp Sludge (Seisi suragi kara kenshutsu sareta shian kagobutsu ni tsuite no tsuiseki chosa), W78-01174	5B		Influence of Certain Factors on Rainfall Frequency Values, W78-01144	2B	REMEDIES	Lake St. Lucia: Mathematical Modelling and Evaluations of Ameliorative Measures, W78-01006	2H
PUMP TURBINES			Monsoon in Sierra Leone, W78-01145	2B	REMOTE SENSING	Microwave Remote Sensing of Soil Water Content, W78-01056	2G
Installation, Operation and Maintenance of Vertical Turbine Pumps, W78-00961	8C		Rainfall Intensity-Frequency Relationships from Monthly Extremes, W78-01149	2B		Detection of Soil Moisture and Soil Characteristics from Skylab, W78-01058	7B
PUMPS			RAINFALL FREQUENCY			Computer-Aided Analysis of Skylab Multispectral Scanner Data in Mountainous Terrain for Land Use, Forestry, Water Resource, and Geologic Applications, W78-01059	7B
Mining Pumps for Heads in Excess of 1,500 M, W78-00930	8C		Rainfall Intensity-Frequency Relationships from Monthly Extremes, W78-01149	2B		Advection in the Peru Current as Observed by Satellite, W78-01137	7B
A Simple Portable Vacuum Pump, W78-00931	5A		RAINFALL INTENSITY			User Requirements and User Acceptance of Current and Next-Generation Satellite Mission and Sensor Complement, Oriented Toward the Monitoring of Water Resources, W78-01155	7B
Installation, Operation and Maintenance of Vertical Turbine Pumps, W78-00961	8C		A High-Resolution Electronic Rainfall Intensity Recorder and Totaliser, W78-01142	2B	RESEARCH AND DEVELOPMENT	A Saltwater Flow-Through Bioassay Method with Controlled Temperature and Salinity, W78-00917	5A
QUARTERNARY PERIOD			RAINFALL-RUNOFF RELATIONSHIPS			The International Crops Research Institute for the Semi-Arid Tropics, W78-01051	10D
Late Pleistocene and Recent Climatic Changes in the Egyptian Sahara, W78-01043	2A		Rainwater and Sediment Runoff from Slopes in the Azov-Kuban Plain, W78-01046	2J	RESEARCH EQUIPMENT	A Plexiglass Subsampling Box for Large Benthos Samples, W78-00913	7B
QUELCCAYA ICE CAP (PERU)			RECREATION			A Saltwater Flow-Through Bioassay Method with Controlled Temperature and Salinity, W78-00917	5A
Radiocarbon Dating of the Last Glaciation in Peru, W78-01009	2C		Improved Procedures for Valuation of the Contribution of Recreation to National Economic Development, W78-01003	6B		The International Crops Research Institute for the Semi-Arid Tropics, W78-01051	10D
RADAR			Hiker Perception of Wilderness: A Study of the Social Carrying Capacity of the Grand Canyon, W78-01047	6B	RESEARCH FACILITIES	The International Crops Research Institute for the Semi-Arid Tropics, W78-01051	10D
Ocean Surface Currents Mapped by Radar, W78-01133	2L		The Impact of Second-Home Development on Water Availability in North Central Arizona, W78-01052	4C		Reservoir Capacity for Periodic-Stochastic Input and Periodic Output, W78-01012	4A
RAADIOACTIVE DATING			RECREATION FACILITIES		RESERVOIR STORAGE	Naval Stores Wastewater Purification and Reuse by Activated Carbon Treatment, W78-01160	5D
Radiocarbon Dating of the Last Glaciation in Peru, W78-01009	2C		Hiker Perception of Wilderness: A Study of the Social Carrying Capacity of the Grand Canyon, W78-01047	6B		Naval Stores Wastewater Purification and Reuse by Activated Carbon Treatment, W78-01160	5D
RADIOACTIVE EFFECTS			RECYCLING		RESINS	Naval Stores Wastewater Purification and Reuse by Activated Carbon Treatment, W78-01160	5D
Effect of Water Stress on Proline Synthesis from Radioactive Precursors, W78-01042	2I		Innovative Rinse-and-Recovery System for Metal Finishing Processes, W78-01165	5D		Naval Stores Wastewater Purification and Reuse by Activated Carbon Treatment, W78-01160	5D
RADIOCHEMICAL ANALYSIS			Elimination of Pollution from Cottage Cheese Whey by Drying and Utilization, W78-01167	5D	RESISTIVITY	Electrical Resistivity for Estimating Permeability, W78-01010	2F
Effects of Burrowing Tubificid Worms on the Exchange of Phosphorus Between Lake Sediment and Overlying Water, W78-00921	5C		State of the Art: Wastewater Management in the Beverage Industry, W78-01168	5D			
Residue Analyses on 2-Amino-4-phenylthiazole, a Piscine Anesthetic, in Fishes - III Metabolism in Rainbow Trout and Carp, W78-00923	5A		Utilization of Cheese Whey for Wine Production, W78-01170	5E			
RADIOMETERS			RED MOUNTAIN PASS (COLO)				
Detection of Soil Moisture and Soil Characteristics from Skylab, W78-01058	7B		Avalanche Release and Snow Characteristics, San Juan Mountains, Colorado, W78-01062	2C			
RAIN GAGES			RED RIVER				
A High-Resolution Electronic Rainfall Intensity Recorder and Totaliser, W78-01142	2B		The Interrelationships of the Longitudinal Profiles and Channel Pattern for the Red River, W78-01146	2E			
RAINBOW TROUT							
Residue Analyses on 2-Amino-4-phenylthiazole, a Piscine Anesthetic, in Fishes - III Metabolism in Rainbow Trout and Carp, W78-00923	5A						

SUBJECT INDEX

SATELLITES (ARTIFICIAL)

RESPIRATION

The Influence of Ammonia on the Oxygen Delivery System of Coho Salmon Hemoglobin, W78-00916 5C

Rate of Leaf Production and Senescence and Effect of Leaf Age on Net Gas Exchange in Creosotebush, W78-01054 2I

RETAINING WALLS

Stability of Gobi Block Revetment to Wave Attack, W78-01027 8F

REVERSE OSMOSIS

Reverse Osmosis Field Test: Treatment of Watts Nickel Rinse Waters, W78-01161 5D

REVIEWS

Toxicity to Fish of Cyanides and Related Compounds -- A Review, W78-00927 5C

Eutrophication of Lakes, W78-01020 5C

Threshold of Sediment Motion Under Unidirectional Currents, W78-01030 2J

RIP CURRENTS

A Mechanism for Rip Current Generation on an Open Coast, W78-00976 2L

RISSLE MARKS

Vortex Generation by Oscillatory Flow Over Rippled Surfaces, W78-00979 2L

RIVERS

The River Skawa: Water Chemistry and Eutrophication, (In Polish), W78-00990 2K

1974 Ice Breakup on the Chena River, W78-01013 2C

Research on the Water Quality of the River Taro from Fornova to the Mouth (In Italian), W78-01016 5B

Possible Effect of Sediments and Channel Processes on Runoff Redistribution in a River Delta, W78-01029 2J

Water Quality Studies of Sixteen Minnesota Rivers Tributary to Lake Superior, W78-01036 5A

Detroit River Flow Characteristic and Their Application to Chemical Loading Estimates, W78-01037 2E

Direct Measurements of Secondary Currents in River Bends, W78-01067 2E

Calcium Carbonates in Suspended Deposits of Rivers and Irrigation Systems in Central Asia (In Russian), W78-01072 2J

Hydrologic Analysis and River-Quality Data Programs, W78-01079 7A

The Interrelationships of the Longitudinal Profiles and Channel Pattern for the Red River, W78-01146 2E

Umpqua River Entrance, Oregon.

W78-01152 8B

Ice Force Measurements on the Pembina River, Alberta, Canada, W78-01154 2C

ROADS

Analysis of Street Sweepings, Portland, Oregon, W78-01077 5A

ROTARY DRILLING

Cavitating Bit Jets Promise Faster Drilling for Deep-Hole Operations, W78-00957 8C

Optimizing Penetration Rate, Part 1: Determining Parameters That Affect Rate of Penetration, W78-00959 8A

Optimizing Penetration Rate, Conclusion: Computer Optimizes Operations, W78-00960 8A

Unique Bit Design Improves Hydraulics and Performance, W78-00963 8C

Downhole Drilling Motor Creates High Torque at Low Speeds, W78-00964 8C

ROTS

Mechanisms of Survival of Zoospores of Phytophthora Parasitica in Irrigation Water, W78-01055 3F

RUNOFF

Rainwater and Sediment Runoff from Slopes in the Azov-Kuban Plain, W78-01046 2J

Maryland Highway Drainage Study: Volume VIII - A Physical Simulation Model of Runoff into Highway Cracks, W78-01064 8B

Effects of Urban Lakes on Surface Runoff and Water Quality, W78-01135 2E

A Study Into the Low-Flow Characteristics of British Rivers, W78-01148 2E

SAGINAW BAY

Results from a Numerical Model for Simulating Circulation Patterns and Chlorinity Distributions in Saginaw Bay, W78-01040 2H

Free Mode Coupling of Saginaw Bay and Lake Huron, W78-01041 2H

SAHARA DESERT

Late Pleistocene and Recent Climatic Changes in the Egyptian Sahara, W78-01043 2A

SALINE LAKES

Lake St. Lucia: Mathematical Modelling and Evaluations of Ameliorative Measures, W78-01006 2H

SALINE WATER

Use of Salt (NaCl) Water to Reduce Mortality of Chinook Salmon Smolts, *Oncorhynchus tshawytscha*, During Handling and Hauling, W78-00909 5G

SALINE WATER-FRESHWATER INTERFACES

Lake St. Lucia: Mathematical Modelling and Evaluations of Ameliorative Measures, W78-01006 2H

Summary of Ground-Water Conditions in the Jaffna Peninsula, Republic of Sri Lanka, With a Plan for Investigating Feasibility of Ground-Water Development, W78-01093 4B

SALINITY

Use of Salt (NaCl) Water to Reduce Mortality of Chinook Salmon Smolts, *Oncorhynchus tshawytscha*, During Handling and Hauling, W78-00909 5G

A Saltwater Flow-Through Bioassay Method with Controlled Temperature and Salinity, W78-00917 5A

Results from a Numerical Model for Simulating Circulation Patterns and Chlorinity Distributions in Saginaw Bay, W78-01040 2H

SALMON

The Influence of Ammonia on the Oxygen Delivery System of Coho Salmon Hemoglobin, W78-00916 5C

SALT TOLERANCE

Use of Salt (NaCl) Water to Reduce Mortality of Chinook Salmon Smolts, *Oncorhynchus tshawytscha*, During Handling and Hauling, W78-00909 5G

SAMPLING

A Plexiglass Subsampling Box for Large Benthos Samples, W78-00913 7B

A Quantitative Sampler for Aquatic Macrophytes, W78-00929 7B

A Simple Portable Vacuum Pump, W78-00931 5A

Sampling of Industrial Wastewater Helps Meet Discharge Standards, W78-01073 7B

SAN JUAN MOUNTAINS (COLO)

Computer-Aided Analysis of Skylab Multispectral Scanner Data in Mountainous Terrain for Land Use, Forestry, Water Resource, and Geologic Applications, W78-01059 7B

Avalanche Release and Snow Characteristics, San Juan Mountains, Colorado, W78-01062 2C

SANGAMON RIVER (ILL)

Three-Dimensional Seepage Model Study Oakley Dam, Sangamon River, Illinois, W78-01068 8B

SAPROLEGIA

Use of Salt (NaCl) Water to Reduce Mortality of Chinook Salmon Smolts, *Oncorhynchus tshawytscha*, During Handling and Hauling, W78-00909 5G

SATELLITES (ARTIFICIAL)

Computer-Aided Analysis of Skylab Multispectral Scanner Data in Mountainous Terrain for Land Use, Forestry, Water Resource, and Geologic Applications, W78-01059 7B

SUBJECT INDEX

SATELLITES (ARTIFICIAL)

Comparison of Different Methods for Estimating Snowcover in Forested, Mountainous Basins Using LANDSAT (ERTS) Images, W78-01095	7B	Depressed Weir with Two Unequal Sheetpiles in Anisotropic Soil, W78-01151	2G	Linked with the Big Sewer of Marseille-Cor-tiou, (In French), W78-01015	5C
User Requirements and User Acceptance of Current and Next-Generation Satellite Mission and Sensor Complement, Oriented Toward the Monitoring of Water Resources, W78-01155	7B	SEEPAGE CONTROL		SHEET PILING	
SEA SURFACE TEMPERATURE		Three-Dimensional Seepage Model Study Oakley Dam, Sangamon River, Illinois, W78-01068	8B	Depressed Weir with Two Unequal Sheetpiles in Anisotropic Soil, W78-01151	2G
Pacific Sea-Surface Temperature Related to Rain in California, W78-01066	2B	SEICHES		SHELLFISH	
SEA WATER		Free Mode Coupling of Saginaw Bay and Lake Huron, W78-01041	2H	Spectrofluorometric Differentiation of the Red Tide Alga, <i>Gonyaulax Tamarensis</i> from Other Algae Common to New England Waters, W78-00950	5C
Content and Uptake of Trace Metals in Benthic Algae, Enteromorpha and Porphyra II. Studies on the Algae Cultured in Sea Water Supplemented with Various Metals, W78-00924	5B	SELF-PURIFICATION		SHIPS	
SEASONAL		Microbial Self-Purification by the Lagoon Method, (In French), W78-00910	5D	Catalytic Waste Treatment Systems for Great Lake Ore Carriers, W78-01157	5D
Phytoplankton, Phytoplankton Growth and Biomass Cycles in an Unpolluted and in a Polluted Polar Lake, W78-00920	5C	SEMIARID CLIMATES		SHORES	
SEDIMENT CONTROL		The International Crops Research Institute for the Semi-Arid Tropics, W78-01051	10D	Analysis of Inhomogeneous Wave Number Spectra, W78-00978	2L
Umpqua River Entrance, Oregon, W78-01152	8B	SEPARATION TECHNIQUES		SIERRA LEONE	
SEDIMENT TRANSPORT		Catalytic Waste Treatment Systems for Great Lake Ore Carriers, W78-01157	5D	Monsoon in Sierra Leone, W78-01145	2B
Erosion and Transport of Bed-Load Sediment, W78-01060	2J	Dialysis for Concentration and Removal of Industrial Wastes, W78-01162		5D	SILVER
SEDIMENT-WATER INTERFACES		Foam Flotation Treatment of Heavy Metals and Fluoride-Bearing Industrial Wastewaters, W78-01164	5D	Patella Vulgata: A Biological Monitor of Coastal Metal Pollution - A Preliminary Study, W78-00906	5A
Effects of Burrowing Tubificid Worms on the Exchange of Phosphorus Between Lake Sediment and Overlying Water, W78-00921	5C	Extraction of Chemical Pollutants from Industrial Wastewaters with Volatile Solvents, W78-01171		5D	SIMULATION ANALYSIS
SEDIMENTATION		Metal Removal and Cyanide Destruction in Plating Wastewaters Using Particle Bed Electrodes, W78-01173	5D	Three-Dimensional Seepage Model Study Oakley Dam, Sangamon River, Illinois, W78-01068	8B
Threshold of Sediment Motion Under Unidirectional Currents, W78-01030	2J	SEPTIC TANKS		Numerical Modeling of Pollutant Transport Using a Lagrangian Marker Particle Technique, W78-01069	
Water and Related Problems in Coal-Mine Areas of Alabama, W78-01094	5B	Environmental Effects of Septic Tank Systems, W78-00967	5B	Hydrologic and Chemical Budgets on Walker Branch Watershed-Observations and Modeling Applications, W78-01071	2A
SEDIMENTS		SETTLING BASINS		SKYLAB	
Relationships Between the Bivalve <i>Macoma Balthica</i> and Bacteria in Intertidal Sediments: Minas Basin, Bay of Fundy, W78-00905	5C	Effective Textile Industry Effluent Treatment, W78-01175	5D	Detection of Soil Moisture and Soil Characteristics from Skylab, W78-01058	7B
Mechanics of Suspended Sediment in Random Waves, W78-00980	2L	SEWAGE		SOIL	
Sulfur Content of Sediments of the Marin Estuary and Other Galician Estuaries, (In Spanish), W78-00986	2K	Seawage Purification, W78-00996	5D	Computer-Aided Analysis of Skylab Multispectral Scanner Data in Mountainous Terrain for Land Use, Forestry, Water Resource, and Geologic Applications, W78-01059	7B
Methods for Identifying and Evaluating the Nature and Extent of Non-point Sources of Pollutants, W78-01024	5B	SEWAGE DISPOSAL		SLOPE PROTECTION	
Sediment Distribution and Bottom Topography of Southeastern Lake Superior, W78-01034	2J	Environmental Effects of Septic Tank Systems, W78-00967	5B	Rainwater and Sediment Runoff from Slopes in the Azov-Kuban Plain, W78-01046	2J
SEEPAGE		SEWAGE TREATMENT		SLUDGE DISPOSAL	
Three-Dimensional Seepage Model Study Oakley Dam, Sangamon River, Illinois, W78-01068	8B	Seawage Purification, W78-00996	5D	Sanitary Landfills, A Bibliography, Volume 2, W78-01004	5E
Recent Evolution of the Different Levels of Marine Pollution of the Soft Substratum		SEWERAGE		SLUDGE TREATMENT	
Shield-Protected Tunneling Machine Drives Sewer Under City Streets, W78-00993	8A	Electricity Independence for Two Municipal Services, W78-00991	5D	Chemical Agents Used in the Effluent Treatment Plant (Pomoce chemicke pro stredky v cistirne odpadnick vod), W78-00987	5D
		Anchoring a Force Main in Sand, W78-00992	8A	Mechanical Dewatering of Sediments from Roofing Board Factory Effluents (Opyt mekhanicheskogo obezvozzhivaniya osadkov stochnykh vod kartonno-ruberoidnykh zavodov), W78-01120	5E

SUBJECT INDEX

STREET SWEEPINGS

Results of an NCASI Pilot Plant Study of Mechanical Dewatering Alternatives for Waste Activated Sludge, W78-01123	5D	SOIL SURVEYS	Soil Survey Interpretations for Earth Dams, W78-00938	8D	SPECTROSCOPY	Residue Analyses on 2-Amino-4-phenylthiazole, a Piscine Anesthetic, in Fishes - III Metabolism in Rainbow Trout and Carp, W78-00923	5A
Start-up and Operating Experience with a Twin Wire Moving Belt Press for Primary Sludge, W78-01129	5D	SOIL WATER	Assessment of Dryness and Wetness Based on Precipitation, Water Supply in the Soil and Potential Evapotranspiration (In Serbo-Croatian), W78-01017	2B	SPOIL BANKS	Feasibility of Elk Creek Acid Mine Drainage Abatement Project, W78-01159	5D
Ammonium-Carbonate Leaching of Metal Values from Water-Treatment Sludges, W78-01166	5D	SOIL WATER MOVEMENT	Water and Chloride Movement Through Soil Columns Simulating Pedal Soils, W78-01011	2G	SPRINKLER IRRIGATION	Tests on Sprinklers (In Afrikaans), W78-00944	3F
SLURRIES		SOILS	Water and Chloride Movement Through Soil Columns Simulating Pedal Soils, W78-01011	2G	SPRINKLERS	Tests on Sprinklers (In Afrikaans), W78-00944	3F
Comparative Assessment of Water Use and Environmental Implications of Coal Slurry Pipelines, W78-01085	8A	SOLAR ENERGY	Tethering Solar Power in Rhodesia. W78-00936	3D	STABILITY	Stability of Gobi Block Revetment to Wave Attack, W78-01027	8F
SMALL SLOPE CHANNELS		SOLAR RADIATION	Solar Activity and Rainfall Variation Over Southern Africa, W78-00939	2B	STOCHASTIC PROCESSES	Area-Deficit-Intensity Characteristics of Droughts, W78-01025	2B
Friction Factors for Vegetated Waterways of Small Slope, W78-01031	2E	SOLUTE CONCENTRATIONS	Nitrogen Loads and Concentrations in Florida Streams, W78-01082	7C	STORM DRAINS	Anchoring a Force Main in Sand. W78-00992	8A
SMOLT		SOLUTES	Soil Transfer, with Exchange Between Mobile and Stagnant Water, Through Unsaturated Sand, W78-01065	2G	STORM SURGE	An Analysis of Drag Coefficient at Hurricane Windspeeds from a Numerical Simulation of Dynamical Water Level Changes in Lake Okeechobee, Florida, W78-01023	2H
Use of Salt (NaCl) Water to Reduce Mortality of Chinook Salmon Smolts, <i>Oncorhynchus tshawytscha</i> , During Handling and Hauling, W78-00909	5G	SOLVENT EXTRactions	Extraction of Chemical Pollutants from Industrial Wastewaters with Volatile Solvents, W78-01171	5D	STRAIN GAUGES	Measurement of Periodic Open and Shut Shell Movement of Bivalves by the Strain-Gauge Method, W78-00911	7B
SNAKE RIVER (WASH)		SOLVENTS	Dialysis for Concentration and Removal of Industrial Wastes, W78-01162	5D	STRaits OF MACKINAC	Distribution of Water Masses in and Near the Straits of Mackinac, W78-01038	2H
Use of Salt (NaCl) Water to Reduce Mortality of Chinook Salmon Smolts, <i>Oncorhynchus tshawytscha</i> , During Handling and Hauling, W78-00909	5G	Extraction of Chemical Pollutants from Industrial Wastewaters with Volatile Solvents, W78-01171	5D	STRATIGRAPHY	Summary of Geologic and Hydrologic Information Pertinent to Tunneling in Selected Urban Areas, W78-01090	8B	
SNOW		SOUTH AMERICA	Radioisotope Dating of the Last Glaciation in Peru, W78-01009	2C	STREAMFLOW	Hydrologic Data for the Vamoosa Aquifer, East-Central Oklahoma, W78-01076	2A
Avalanche Release and Snow Characteristics, San Juan Mountains, Colorado. W78-01062	2C	Advection in the Peru Current as Observed by Satellite, W78-01137	7B	Fitting the Pearson Type 3 Distribution in Practice, W78-01136	2E		
SNOW COVER		SOUTHAMPTON (ENGLAND)	Simulation of the Inlet Hydrograph for Urban Catchments, W78-01147	2E	STREAMS	Nitrogen Loads and Concentrations in Florida Streams, W78-01082	7C
Detection of Soil Moisture and Soil Characteristics from Skylab, W78-01058	7B	SPAWNING	Effect of Chronic Exposure of Brook Trout to Sublethal Concentrations of Hydrogen Cyanide, W78-00915	5C	STREET SWEEPINGS	Observed Mixing Lengths in Mountain Streams, W78-01150	2E
SOIL ABSORPTION FIELDS		SPECTROPHOTOMETRY	Spectrophotometric Determination of Mineral Oils in Water, (In Russian), W78-00912	5A	Analysis of Street Sweepings, Portland, Oregon, W78-01077	5A	
Environmental Effects of Septic Tank Systems, W78-00967	5B						
SOIL COMPACTION							
Air Regime of Nonirrigated and Irrigated Ciscaucasian Chernozems, W78-01049	3F						
SOIL MOISTURE							
Microwave Remote Sensing of Soil Water Content, W78-01056	2G						
Detection of Soil Moisture and Soil Characteristics from Skylab, W78-01058	7B						
SOIL PROPERTIES							
Methylation of Mercury in a Terrestrial Environment, W78-00926	5B						
Protection of a Unique Ecological Area Through Improved Water and Fertility Management, W78-01001	2G						
Air Regime of Nonirrigated and Irrigated Ciscaucasian Chernozems, W78-01049	3F						

SUBJECT INDEX

STRONTIUM

STRONTIUM

Patella Vulgata: A Biological Monitor of Coastal Metal Pollution - A Preliminary Study,
W78-00906 5A

SUBCRITICAL FLOW

Transition from Subcritical to Supercritical Flow,
W78-00975 8B

SUBMERGED PLANTS

A Quantitative Sampler for Aquatic Macrophytes,
W78-00929 7B

SUBSURFACE MAPPING

Thickness of the Potable-Water Zone in the Floridan Aquifer,
W78-01081 2F

SUGAR CANE

Irrigation of Sugar Cane,
W78-00928 3F

SUGARCANE

Implementation of Field Layout for Mechanization and Surface Water Control,
W78-00942 4A

SULFATES

Study of Factors Influencing the Physico-Chemical Purification of Pulp and Paper Industry Waste Waters With Aluminum Sulfate (Studiul factorilor care influenteaza epurarea fizico-chimica a apelor reziduale din industria celulozii si hirtiei),
W78-00983 5D

Sulphate Removal from Carbonising and Dyeing Waste Waters.
W78-01176 5D

SULFIDES

Leather Tannery Waste Management Through Process Change, Reuse and Treatment,
W78-01156 5D

The Origin, Treatment and Disposal of Tannery Effluents,
W78-01181 5D

SULFITE LIQUORS

Effect of Various Technological Factors on the Color of Pulp Mill Effluents (Wplyw roznich czynnikow technologicznych na barwe sciekow pocelulozowych),
W78-00989 5B

New In-Plant Technology to Reduce Pollution from a Sodium-Base Sulfite Mill,
W78-01104 5D

SULFITE PULP MILLS

New In-Plant Technology to Reduce Pollution from a Sodium-Base Sulfite Mill,
W78-01104 5D

Total Water System (AT) Coshocton Mill (OF) Stone Container Corporation,
W78-01124 3E

SULFUR

Sulfur Content of Sediments of the Marin Estuary and Other Galician Estuaries, (In Spanish),
W78-00986 2K

SULFUR COMPOUNDS

Sulphate Removal from Carbonising and Dyeing Waste Waters.
W78-01176 5D

SUPERCRITICAL FLOW

Transition from Subcritical to Supercritical Flow,
W78-00975 8B

SURF ZONE

Mechanics of Suspended Sediment in Random Waves,
W78-00980 2L

SURFACE CURRENTS

Ocean Surface Currents Mapped by Radar,
W78-01133 2L

SURFACE IRRIGATION

Cost Comparison of Drip and Flood Irrigations Systems,
W78-01048 3F

SURFACE RUNOFF

Treatment System is Innovative for Coal Storage Facility,
W78-01074 5D

SURFACE WATERS

Water Resources Data for Missouri, Water Year 1976.
W78-01083 7C

Water Resources Data for Tennessee, Water Year 1975.
W78-01091 7C

Water Resources Data for Oregon, Water Year 1976.
W78-01092 7C

Public Water Supplies of Selected Municipalities in Florida, 1975,
W78-01098 6D

SURVEYS
Quantitative Map Interpretation in Regional Planning Surveys (In Afrikaans),
W78-00934 7C

Environmental Inventory and Assessment of Navigation Pools 24, 25, and 26, Upper Mississippi and Lower Illinois Rivers; Summary Report,
W78-01028 6G

Water Quality Studies of Sixteen Minnesota Rivers Tributary to Lake Superior,
W78-01036 5A

Distribution of Water Masses in and Near the Straits of Mackinac,
W78-01038 2H

User Requirements and User Acceptance of Current and Next-Generation Satellite Mission and Sensor Complement, Oriented Toward the Monitoring of Water Resources,
W78-01155 7B

SUSPENDED SOLIDS
Mechanics of Suspended Sediment in Random Waves,
W78-00980 2L

Experiments on the Optimization of Solids Recovery from Excess Recirculated Paper Mill White Water in Sveen-Pedersen Savealls (Incerari de optimizare a procesului de recuperare a materialului din apele re circulante excedentare de la fabricarea hirtiei, la recuperatorul Sveen-Pedersen),
W78-00982 5D

Analysis and Characterization of Suspended Solids in Pulp and Paper Mill Effluent,
W78-01102 5A

SWANS

Swan Mortality Due to Certain Heavy Metals in the Mission Lake Area, Idaho,
W78-00903 5C

SWIMMING POOLS

Is Your Swimming Pool Safe.
W78-00932 5F

TAILRACE

Filling and Emptying System, Little Goose Lock, Snake River, Washington, Hydraulic Model Investigation,
W78-01061 8A

TAMPA AREA (FLORIDA)

A Hydrologic Description of Keystone Lake Near Tampa, Florida,
W78-01088 2H

TANNERY WASTES

Leather Tannery Waste Management Through Process Change, Reuse and Treatment,
W78-01156 5D

The Origin, Treatment and Disposal of Tannery Effluents,
W78-01181 5D

TAPES JAPONICA

Measurement of Periodic Open and Shut Shell Movement of Bivalves by the Strain-Gauge Method,
W78-00911 7B

TEMPERATURE

A Saltwater Flow-Through Bioassay Method with Controlled Temperature and Salinity,
W78-00917 5A

TEMPERATURE EFFECT

The Effect of Large Dams on River Water Temperature Below the Dams, with Special Reference to Bilharzia and the Verwoerd Dam,
W78-00997 6G

TEMPORAL DISTRIBUTION

Fitting the Pearson Type 3 Distribution in Practice,
W78-01136 2E

TENNESSEE

Water Resources Data for Tennessee, Water Year 1975.
W78-01091 7C

TERRACE-CHANNEL DESIGN

Friction Factors for Vegetated Waterways of Small Slope,
W78-01031 2E

TEXAS HIGH PLAINS

Development of an Unconventional Approach to Nitrification-Denitrification,
W78-01002 5D

TEXTILES

Effective Textile Industry Effluent Treatment.
W78-01175 5D

Sulphate Removal from Carbonising and Dyeing Waste Waters.
W78-01176 5D

MODERN METHODS OF EFFLUENT TREATMENT

Modern Methods of Effluent Treatment,
W78-01177 5D

Capital Cost-Saving Service for Textile Effluent Treatment.
W78-01178 5D

SOME THOUGHTS ON WATER CONSERVATION AND REUSE OF PROCESS LIQUORS

Some Thoughts on Water Conservation and Reuse of Process Liquors.
W78-01179 5D

SUBJECT INDEX

URBANIZATION

TIDAL EFFECTS	Trace Element Concentrations in Marine Organisms from the Cape West Coast, W78-00937	5B
Relationships Between the Bivalve <i>Macoma Balthica</i> and Bacteria in Intertidal Sediments: Minas Basin, Bay of Fundy, W78-00905		5C
TISSUE ANALYSIS	Effects of Burrowing Tubificid Worms on the Exchange of Phosphorus Between Lake Sediment and Overlying Water, W78-00921	5C
Role of Un-ionized Ammonia in Predisposing Gill Apparatus of <i>Alburnus alburnus alborella</i> to Fungal and Bacterial Diseases, W78-00918		5C
TOBACCO	Residue Analyses on 2-Amino-4-phenylthiazole, a Piscine Anesthetic, in Fishes - III Metabolism in Rainbow Trout and Carp, W78-00923	5A
The Influence of Fertilizer-Applied Chlorine, Chlorine Content of Irrigation Water and Leaching of Chlorine on the Uptake of Chlorine By Tobacco (In Afrikaans), W78-00943		3F
TOPOGRAPHY	Solute Transfer, with Exchange Between Mobile and Stagnant Water, Through Unsaturated Sand, W78-01065	2G
Sediment Distribution and Bottom Topography of Southeastern Lake Superior, W78-01034		2J
TOXICITY	Transition from Subcritical to Supercritical Flow, W78-00975	8B
Toxicities of 'Excessively' Chlorinated Organic Compounds, W78-00901		5C
Swan Mortality Due to Certain Heavy Metals in the Mission Lake Area, Idaho, W78-00903		5C
Fenitrothion Toxicity to the Freshwater Crayfish, <i>Orconectes limosus</i> , W78-00904		5C
Effect of Chronic Exposure of Brook Trout to Sublethal Concentrations of Hydrogen Cyanide, W78-00915		5C
Acute Toxicity of Four Organophosphorus Insecticides to a Freshwater Teleost <i>Channa punctatus</i> (Bloch), W78-00919		5C
Effect of Hydrogen Sulfide on Fish and Invertebrates Part II-Hydrogen Sulfide Determination and Relationship Between pH and Sulfide Toxicity, W78-00925		5C
Toxicity to Fish of Cyanides and Related Compounds - A Review, W78-00927		5C
The Role of Toxic Compounds in the Revision of the 1983 Effluent Guidelines, W78-01122		6E
Detoxification of Bleached Kraft Mill Effluents - A Manageable Problem, W78-01127		5D
Toxicity, BOD, and Colour of Effluents from the Kraft Pulp Mill of Bole Wood Containing High Quantities of Bark, W78-01128		5B
TRACE ELEMENTS	Effects of Burrowing Tubificid Worms on the Exchange of Phosphorus Between Lake Sediment and Overlying Water, W78-00921	5C
Patella Vulgata: A Biological Monitor of Coastal Metal Pollution - A Preliminary Study, W78-00906		5A
Content and Uptake of Trace Metals in Benthic Algae, <i>Enteromorpha</i> and <i>Porphyra</i> I. Measurement and Variation of Trace Metal Content of <i>Porphyra</i> Grown in Natural Environment, W78-00908		5B
TRACERS	Residue Analyses on 2-Amino-4-phenylthiazole, a Piscine Anesthetic, in Fishes - III Metabolism in Rainbow Trout and Carp, W78-00923	5A
Effects of Burrowing Tubificid Worms on the Exchange of Phosphorus Between Lake Sediment and Overlying Water, W78-00921		5C
TRANSFER	Solute Transfer, with Exchange Between Mobile and Stagnant Water, Through Unsaturated Sand, W78-01065	2G
Comparative Assessment of Water Use and Environmental Implications of Coal Slurry Pipelines, W78-01085		8A
TRANSPORTATION	Experiments on the Optimization of Solids Recovery from Excess Recirculated Paper Mill White Water in Sveen-Pedersen Savealls (Incerari de optimizare a procesului de recuperare a materialului din apele re circulante excedentare de la fabricarea hirtiei, la recuperatorul Sveen-Pedersen), W78-00982	5D
Electricity Independence for Two Municipal Services, W78-00991		5D
Interceptor Installation for Yuba City, California, W78-00994		5D
Treatment Plant for Effluent from the Albruck Paper Mill, W78-01121		5D
Physical-Chemical Treatment System at Fitchburg, Massachusetts, W78-01125		5D
Water Quality Protection at the (Simpson Paper Company) Shasta Mill, W78-01130		5D
TRITIUM	Residue Analyses on 2-Amino-4-phenylthiazole, a Piscine Anesthetic, in Fishes - III Metabolism in Rainbow Trout and Carp, W78-00923	5A
Effects of Burrowing Tubificid Worms on the Exchange of Phosphorus Between Lake Sediment and Overlying Water, W78-00921		5C
TUBIFICIDS	Summary of Geologic and Hydrologic Information Pertinent to Tunneling in Selected Urban Areas, W78-01090	8B
Water Quality Protection at the (Simpson Paper Company) Shasta Mill, W78-01130		5D
TUNNELING	Summary of Geologic and Hydrologic Information Pertinent to Tunneling in Selected Urban Areas, W78-01090	8B
TURBINES	Downhole Drilling Motor Creates High Torque at Low Speeds, W78-00964	8C
Residual Flow and Boundary Shear Stress in the Turbulent Bottom Layer Beneath Waves, W78-01139		2L
U.S. GEOLOGICAL SURVEY PROJECTS (ALASKA)	The United States Geological Survey in Alaska: Accomplishments During 1976, W78-01096	7C
ULTIMATE DISPOSAL	Pyrolysis of Industrial Wastes for Oil and Activated Carbon Recovery, W78-01172	5E
UMPQUA RIVER (ORE)	Umpqua River Entrance, Oregon, W78-01152	8B
UN WATER CONFERENCE (MAR DEL PLATA 1977)	Report of the United Nations Water Conference, Mar Del Plata, 14-25 March 1977, W78-00972	6E
UNDERGROUND INJECTION CONTROL	Underground Injection Program Set Under Safe Drinking Water Act, W78-00955	6E
UNITED NATIONS	Report of the United Nations Water Conference, Mar Del Plata, 14-25 March 1977, W78-00972	6E
UNITED STATES	Summary of Geologic and Hydrologic Information Pertinent to Tunneling in Selected Urban Areas, W78-01090	8B
Water Consumption by Nuclear Powerplants and Some Hydrological Implications, W78-01097		7C
Environmental Impact Assessments for U.S. and Canadian Industries, W78-01099		5C
URBAN AREAS	Summary of Geologic and Hydrologic Information Pertinent to Tunneling in Selected Urban Areas, W78-01090	8B
URBAN HYDROLOGY	Simulation of the Inlet Hydrograph for Urban Catchments, W78-01147	2E
URBAN RUNOFF	Analysis of Street Sweepings, Portland, Oregon, W78-01077	5A
Simulation of the Inlet Hydrograph for Urban Catchments, W78-01147		2E
URBANIZATION	Policy Implications of Urban Land Practices for Groundwater Quality, W78-00958	4C

SUBJECT INDEX

USER SURVEYS

USER SURVEYS

User Requirements and User Acceptance of Current and Next-Generation Satellite Mission and Sensor Complement, Oriented Toward the Monitoring of Water Resources,
W78-01155

7B

USS ENVIRONMENTAL PROTECTION AGENCY

Underground Injection Program Set Under Safe Drinking Water Act,
W78-01155

6E

USSR

Possible Effect of Sediments and Channel Processes on Runoff Redistribution in a River
D-
V-0029

2J

VARIABILITY

Short-Term Transient Variations of Limnological Parameters in Grand Traverse Bay, Lake Michigan,
W78-01033

2H

VEGETATION EFFECTS

Friction Factors for Vegetated Waterways of Small Slope,
W78-01031

2E

VORTICES

Vortex Generation by Oscillatory Flow Over Rippled Surfaces,
W78-00979

2L

Filling and Emptying System, Little Goose Lock, Snake River, Washington, Hydraulic Model Investigation,
W78-01061

8A

WASHINGTON

Filling and Emptying System, Little Goose Lock, Snake River, Washington, Hydraulic Model Investigation,
W78-01061

8A

WASTE DISCHARGE

Numerical Modeling of Pollutant Transport Using a Lagrangian Marker Particle Technique,
W78-01069

5G

WASTE DISPOSAL

Underground Injection Program Set Under Safe Drinking Water Act,
W78-00955

6E

How Recent Federal Legislation has Moved Toward Greater Protection of Groundwater Resources.
W78-00969

6E

Sanitary Landfills, A Bibliography, Volume 2.
W78-01004

5E

WASTE WATER DISPOSAL

The Impact of Second-Home Development on Water Availability in North Central Arizona,
W78-01052

4C

WASTE WATER (POLLUTION)

Patella Vulgata: A Biological Monitor of Coastal Metal Pollution - A Preliminary Study,
W78-00906

5A

WASTE WATER TREATMENT

Study of Factors Influencing the Physico-Chemical Purification of Pulp and Paper Industry Waste Waters With Aluminum Sulfate (Studiul factorilor care influenteaza epurarea fizico- chimica a apelor reziduale din industria celulozei si hirtiei),
W78-00983

5D

Chemical Precipitation and Sedimentation of Wallboard Mill Waste Water (Kjemisk felling og sedimentering av wallboardvann),
W78-00984

5D

Chemical Agents Used in the Effluent Treatment Plant (Pomocne chemicke prostredky v cistinne odpadnicich vod),
W78-00987

5D

Interceptor Installation for Yuba City, California.
W78-00994

5D

Development of an Unconventional Approach to Nitrification-Denitrification,
W78-01002

5D

Enso-Biox Method - A Biological Method for Purifying Kraft Pulp Mill Condensates,
W78-01100

5D

Adjustments and Innovation in a French Paper Mill (Adjustements et innovations dans une papeterie francaise),
W78-01101

5D

Waste Heat for Evaporation of Effluents,
W78-01105

5D

Bio-Treatment of Effluents with BOD Below 100 MG/Liter,
W78-01109

5D

Lime Treatment of Bleachery Effluent,
W78-01110

5D

Treatment of Pulp and Paper Mill Effluents Using Physical-Chemical Techniques,
W78-01111

5D

Separation and Reuse of Waste Solids from Liquid Effluents,
W78-01112

5D

Utilization of Solids from Waste Water Treatment Plants in Board Manufacture,
W78-01115

5D

Treatment Plant for Effluent from the Albruck Paper Mill,
W78-01121

5D

Physical-Chemical Treatment System at Fitchburg, Massachusetts,
W78-01125

5D

Detoxification of Bleached Kraft Mill Effluents - A Manageable Problem,
W78-01127

5D

Water Quality Protection at the (Simpson Paper Company) Shasta Mill,
W78-01130

5D

Color Increase of Treated Kraft Mill Effluents,
W78-01131

5D

WATER ANALYSIS

Analysis and Characterization of Suspended Solids in Pulp and Paper Mill Effluent,
W78-01102

5A

Instruments for the Detection of Fiber Content in Effluents and for the Classification of Recycled Fibrous Material,
W78-01113

5A

Studies on Low Molecular Weight Compounds in Kraft Bleaching Liquor (In Japanese),
W78-01117

5A

Ascorbimetric Determination of Oxygen Content in Water (Ascorbinometryczna metoda oznaczania zawartosci tlenu w wodzie),
W78-01119

5A

WATER CAPACITORS

The Activity of Trace Metals in Aqueous Systems and the Effect of Corrosion Control Inhibitors,
W78-01057

8G

WATER CHEMISTRY

Toxicities of 'Excessively' Chlorinated Organic Compounds,
W78-00901

5C

WATER CIRCULATION

Results from a Numerical Model for Simulating Circulation Patterns and Chlorinity Distributions in Saginaw Bay,
W78-01040

2H

The Time-Dependent Response of a Circular Basin of Variable Depth to a Wind Stress,
W78-01141

2H

WATER CONSERVATION

Considerations and Possibilities of Optimizing the Water Circuits of the Braila Pulp and Paper Mill (Consideratii si posibilitati privind optimizarea circuitelor apelor de fabricatie la C.C.H.-Braila),
W78-00985

3E

Turning Back the Tides of Long-Time Federal Water Policy,
W78-01044

6E

Disposal and Recycling of Rejects from Waste Paper and Closed Water Systems,
W78-01114

3E

Total Water System (AT) Coshocton Mill (OF) Stone Container Corporation,
W78-01124

3E

WATER CONSUMPTION (EXCEPT CONSUMPTIVE USE)

Water Consumption by Nuclear Powerplants and Some Hydrological Implications,
W78-01097

7C

WATER DEMAND

The Impact of Second-Home Development on Water Availability in North Central Arizona,
W78-01052

4C

WATER LAW

National Water Commission Views Groundwater Protection,
W78-00966

4B

How Recent Federal Legislation has Moved Toward Greater Protection of Groundwater Resources.
W78-00969

6E

WATER LEVELS

The River Skawa: Water Chemistry and Eutrophication, (In Polish),
W78-00990

2K

Free Mode Coupling of Saginaw Bay and Lake Huron,
W78-01041

2H

Ground-Water Levels and Descriptions of Observation Wells in Idaho, 1975,
W78-01089

2F

SUBJECT INDEX

WATER REUSE

WATER MANAGEMENT (APPLIED)

National Water Commission Views Ground-water Protection, W78-00966 4B

Protection of a Unique Ecological Area Through Improved Water and Fertility Management, W78-01001 2G

WATER MEASUREMENT

Sampling of Industrial Wastewater Helps Meet Discharge Standards, W78-01073 7B

WATER POLICY

National Water Commission Views Ground-water Protection, W78-00966 4B

Report of the United Nations Water Conference, Mar Del Plata, 14-25 March 1977. W78-00972 6E

Turning Back the Tides of Long-Time Federal Water Policy, W78-01044 6E

Draining the Water Projects Out of the Pork Barrel, W78-01045 4A

WATER POLLUTION

Methods for Identifying and Evaluating the Nature and Extent of Non-point Sources of Pollutants.

W78-01024 5B

Water and Related Problems in Coal-Mine Areas of Alabama, W78-01049 5B

WATER POLLUTION CONTROL

Impact of Abandoned Wells on Ground Water, W78-00968 6E

How Recent Federal Legislation has Moved Toward Greater Protection of Groundwater Resources. W78-00969 6E

Numerical Modeling of Pollutant Transport Using a Lagrangian Marker Particle Technique, W78-01069 5G

Energy vs. Environment -- Friends or Foes, W78-01103 5D

Process Concepts for Oxygen Delignification, W78-01106 5D

Effluent Quality Improvement in a Bleached Kraft Pulp Mill, W78-01107 5D

WATER POLLUTION EFFECTS

Toxicity to Fish of Cyanides and Related Compounds -- A Review, W78-00927 5C

Recent Evolution of the Different Levels of Marine Pollution of the Soft Substratum Linked with the Big Sewer of Marseille-Cor-tiou. (In French), W78-01015 5C

WATER POLLUTION SOURCES

Underground Injection Program Set Under Safe Drinking Water Act, W78-00955 6E

Environmental Effects of Septic Tank Systems, W78-00967 5B

Water Pollution Investigation: Lower Green Bay and Lower Fox River, W78-01022 5B

Methods for Identifying and Evaluating the Nature and Extent of Non-point Sources of Pollutants. W78-01024 5B

Analysis of Street Sweepings, Portland, Oregon, W78-01077 5A

Water Pollution Caused by Inactive Ore and Mineral Mines - A National Assessment, W78-01158 5B

WATER PURIFICATION

Chemical Precipitation and Sedimentation of Wallboard Mill Waste Water (Kjemisk felling og sedimentering av wallboardvann), W78-00984 5D

Chemical Agents Used in the Effluent Treatment Plant (Pomocne chemicke prostredky v cistirne odpadnicich vod), W78-00987 5D

New State-of-the-Art Automatic Microelectrophoresis Instrumentation, W78-01132 5A

Waste-Water Treatment: Ecological, Technological and Economic Aspects (In German), W78-01163 5D

WATER QUALITY

Water Pollution Investigation: Lower Green Bay and Lower Fox River, W78-01022 5B

Methods for Identifying and Evaluating the Nature and Extent of Non-point Sources of Pollutants. W78-01024 5B

Short-Term Transient Variations of Limnological Parameters in Grand Traverse Bay, Lake Michigan, W78-01033 2H

Water Quality Studies of Sixteen Minnesota Rivers Tributary to Lake Superior, W78-01036 5A

Distribution of Water Masses in and Near the Straits of Mackinac, W78-01038 2H

A Preliminary Appraisal of the Garber-Welling-ton Aquifer, Southern Logan and Northern Oklahoma Counties, Oklahoma, W78-01075 7C

Hydrologic Data for the Vamoosa Aquifer, East-Central Oklahoma, W78-01076 2A

Hydrologic Analysis and River-Quality Data Programs, W78-01079 7A

Lakes of Oregon: Volume 5. Marion County, W78-01080 2H

Water Resources Data for Missouri, Water Year 1976, W78-01083 7C

Ground-Water Resources of the Lower Santiam River Basin, Middle Willamette Valley, Oregon, W78-01084 4B

Reconnaissance of Ground-Water Resources in a Part of the Yampa River Basin Between Craig and Steamboat Springs, Moffat and Routt Counties, Colorado, W78-01086 2F

Maps Showing Ground-Water Conditions in the Southern Part of the Chinle Area, Apache County, Arizona-1976, W78-01087 7C

Water Resources Data for Tennessee, Water Year 1975, W78-01091 7C

Water Resources Data for Oregon, Water Year 1976, W78-01092 7C

Effects of Urban Lakes on Surface Runoff and Water Quality, W78-01135 2E

WATER QUALITY STANDARDS

Toxicity to Fish of Cyanides and Related Compounds -- A Review, W78-00927 5C

The Role of Toxic Compounds in the Revision of the 1983 Effluent Guidelines, W78-01122 6E

WATER RESOURCES

User Requirements and User Acceptance of Current and Next-Generation Satellite Mission and Sensor Complement, Oriented Toward the Monitoring of Water Resources, W78-01155 7B

WATER RESOURCES DEVELOPMENT

Report of the United Nations Water Conference, Mar Del Plata, 14-25 March 1977. W78-00972 6E

Draining the Water Projects Out of the Pork Barrel, W78-01045 4A

Summary of Ground-Water Conditions in the Jaffna Peninsula, Republic of Sri Lanka, With a Plan for Investigating Feasibility of Ground-Water Development, W78-01093 4B

WATER REUSE

Mechanisms of Survival of Zoospores of Phytophthora Parasitica in Irrigation Water, W78-01055 3F

Treatment System is Innovative for Coal Storage Facility, W78-01074 5D

Utilization of Solids from Waste Water Treatment Plants in Board Manufacture, W78-01115 5D

Reverse Osmosis Field Test: Treatment of Watts Nickel Rinse Waters, W78-01161 5D

Innovative Rinse-and-Recovery System for Metal Finishing Processes, W78-01165 5D

Metal Removal and Cyanide Destruction in Plating Wastewaters Using Particle Bed Electrodes, W78-01173 5D

Some Thoughts on Water Conservation and Re-use of Process Liquors, W78-01179 5D

SUBJECT INDEX

WATER SHORTAGE

WATER SHORTAGE
The 1976 and 1977 Drought in California: Extent and Severity, W78-01134 2B

WATER SUPPLY
Report of the United Nations Water Conference, Mar Del Plata, 14-25 March 1977, W78-00972 6E

Public Water Supplies of Selected Municipalities in Florida, 1975, W78-01098 6D

WATER TABLE
Maps Showing Ground-Water Conditions in the Southern Part of the Chile Area, Apache County, Arizona-1976, W78-01087 7C

WATER TEMPERATURE
Some Observed Interrelationships Between the Cover of Aquatic Vegetation and Various Physical Properties of the Water Medium, W78-00941 2I

Pacific Sea-Surface Temperature Related to Rain in California, W78-01066 2B

Advection in the Peru Current as Observed by Satellite, W78-01137 7B

WATER TREATMENT
Ozone: The Water Conditioning Process of the Future Today, W78-00953 5F

Removing Iron from a Water Supply, W78-00954 5F

Continuous Chlorination of Contaminated Water, W78-00971 5D

WATER UTILIZATION
Report of the United Nations Water Conference, Mar Del Plata, 14-25 March 1977, W78-00972 6E

Protection of a Unique Ecological Area Through Improved Water and Fertility Management, W78-01001 2G

Some Thoughts on Water Conservation and Reuse of Process Liquors, W78-01179 5D

WATER WELLS
Well Redevelopment: Part II, W78-00952 3B

Removing Iron from a Water Supply, W78-00954 5F

Gass on Gas, W78-00956 2F

Water Well Industry Codes and Licensing, W78-00970 6E

WATER YIELD
A Preliminary Appraisal of the Garber-Wellington Aquifer, Southern Logan and Northern Oklahoma Counties, Oklahoma, W78-01075 7C

Reconnaissance of Ground-Water Resources in a Part of the Yampa River Basin Between Craig and Steamboat Springs, Moffat and Routt Counties, Colorado, W78-01086 2F

WATERSHEDS (BASINS)

Hydrologic and Chemical Budgets on Walker Branch Watershed-Observations and Modeling Applications, W78-01071 2A

Effects of Urban Lakes on Surface Runoff and Water Quality, W78-01135 2E

A Study Into the Low-Flow Characteristics of British Rivers, W78-01148 2E

WAVE INTERACTIONS

A Mechanism for Rip Current Generation on an Open Coast, W78-00976 2L

WAVE SPECTRA

Analysis of Inhomogeneous Wave Number Spectra, W78-00978 2L

WAVES (WATER)

A Mechanism for Rip Current Generation on an Open Coast, W78-00976 2L

Vortex Generation by Oscillatory Flow Over Rippled Surfaces, W78-00979 2L

Mechanics of Suspended Sediment in Random Waves, W78-00980 2L

Gravity Waves on a Current: The Influence of Vorticity, A Sloping Bed, and Dissipation, W78-01014 2E

Waianae Small-Boat Harbor, Oahu, Hawaii, Design for Wave Protection, Hydraulic Model Investigation, W78-01026 8A

Stability of Gobi Block Revetment to Wave Attack, W78-01027 8F

IFYGL Shipboard Visual Wave Observations vs Wave Measurements, W78-01039 2H

Residual Flow and Boundary Shear Stress in the Turbulent Bottom Layer Beneath Waves, W78-01139 2L

WEIRS

Depressed Weir with Two Unequal Sheetpiles in Anisotropic Soil, W78-01151 2G

WELL ABANDONMENT

Impact of Abandoned Wells on Ground Water, W78-00968 6E

WELL REDEVELOPMENT

Well Redevelopment: Part II, W78-00952 3B

WELL REGULATIONS

Water Well Industry Codes and Licensing, W78-00970 6E

WELL SEALING

Impact of Abandoned Wells on Ground Water, W78-00968 6E

WELLS

Impact of Abandoned Wells on Ground Water, W78-00968 6E

WESTERN UNITED STATES

Comparative Assessment of Water Use and Environmental Implications of Coal Slurry Pipelines, W78-01085 8A

WHISTLING SWAN

Swan Mortality Due to Certain Heavy Metals in the Mission Lake Area, Idaho, W78-00903 5C

WHITE WATER

Experiments on the Optimization of Solids Recovery from Excess Recirculated Paper Mill White Water in Svenn-Pedersen Savealls (Incerari de optimizare a procesului de recuperare a materialului din apele re circulante excedentare de la fabricarea hirtiei, la recuperatorul Svenn-Pedersen), W78-00982 5D

WILLAMETTE RIVER BASIN

Analysis of Street Sweepings, Portland, Oregon, W78-01077 5A

WILLAMETTE VALLEY

Ground-Water Resources of the Lower Santiam River Basin, Middle Willamette Valley, Oregon, W78-01084 4B

WILLINGNESS-TO-PAY FUNCTIONS

Improved Procedures for Valuation of the Contribution of Recreation to National Economic Development, W78-01003 6B

WILTING

Effect of Water Stress on Proline Synthesis from Radioactive Precursors, W78-01042 2I

YAMPA RIVER BASIN (COLORADO)

Reconnaissance of Ground-Water Resources in a Part of the Yampa River Basin Between Craig and Steamboat Springs, Moffat and Routt Counties, Colorado, W78-01086 2F

YEASTS

Utilization of Cheese Whey for Wine Production, W78-01170 5E

ZETA POTENTIAL

New State-of-the-Art Automatic Microelectrophoresis Instrumentation, W78-01132 5A

ZINC

Patella Vulgata: A Biological Monitor of Coastal Metal Pollution - A Preliminary Study, W78-00906 5A

Content and Uptake of Trace Metals in Benthic Algae, Enteromorpha and Porphyra I. Measurement and Variation of Trace Metal Content of Porphyra Grown in Natural Environment, W78-00908 5B

ZOOPLANKTON

Temporal Changes in the Plankton of an Industrialized Estuary, W78-00914 5B

ZOOSPORES

Mechanisms of Survival of Zoospores of Phytophthora Parasitica in Irrigation Water, W78-01055 3F

AUTHOR INDEX

AGRANONIK, R. YA. Mechanical Dewatering of Sediments from Roofing Board Factory Effluents (Opty mekhanicheskogo obezvozhivaniya osadkov stochnykh vod kartonno-ruberoidnykh zavodov), W78-01120	5E	ARTEMOVA, V. A. Spectrophotometric Determination of Mineral Oils in Water, (In Russian), W78-00912	5A	BAYDIN, S. S. Possible Effect of Sediments and Channel Processes on Runoff Redistribution in a River Delta, W78-01029	2J
AHMED, A. E. Neutron Logging Method for Locating the Top of Cement Behind Borehole Casing, W78-00965	7B	ASPINALL, D. Effect of Water Stress on Proline Synthesis from Radioactive Precursors, W78-01042	2I	BELE, J. Regionalization for Forests Based on Their Significance for Water Management (Rajonizace lesu z hlediska jejich vodohospodarskeho vyznamu), W78-01118	3B
AHRENS, J. P. Stability of Gobi Block Revetment to Wave Attack, W78-01027	8F	AUFDERHAAR, W. B. Downhole Drilling Motor Creates High Torque at Low Speeds, W78-00964	8C	BELLAN, G. Recent Evolution of the Different Levels of Marine Pollution of the Soft Substratum Linked with the Big Sewer of Marseille-Corion. (In French), W78-01015	5C
ALLEN, H. E. Short-Term Transient Variations of Limnological Parameters in Grand Traverse Bay, Lake Michigan, W78-01033	2H	AURORA PUBLIENES, M. Microbiological Processes in the Meromictic Lake Valle de San Juan in Cuba (In Russian), W78-01180	2H	BELLELLI, E. Research on the Water Quality of the River Taro from Fornova to the Mouth (In Italian), W78-01016	5B
ALLEN, J. H. Optimizing Penetration Rate, Conclusion: Computer Optimizes Operations, W78-00960	8A	BABINGTON, W. M. Total Water System (AT) Coshocton Mill (OF) Stone Container Corporation, W78-01124	3E	BENSON, W. W. Swan Mortality Due to Certain Heavy Metals in the Mission Lake Area, Idaho, W78-00903	5C
Optimizing Penetration Rate, Part 1: Determining Parameters That Affect Rate of Penetration, W78-00959	8A	BAHNER, L. H. A Saltwater Flow-Through Bioassay Method with Controlled Temperature and Salinity, W78-00917	5A	BERAN, M. A. A Study Into the Low-Flow Characteristics of British Rivers, W78-01148	2E
ALLEN, R. M. Mechanisms of Survival of Zoospores of Phytophthora Parasitica in Irrigation Water, W78-01055	3F	BAILEY, D. A. The Origin, Treatment and Disposal of Tannery Effluents, W78-01181	5D	BERGGREN, K. E. Utilization of Cheese Whey for Wine Production, W78-01170	5E
ALLENDER, J. H. Comparison of Model and Observed Currents in Lake Michigan, W78-01140	2H	BANKS, H. O. National Water Commission Views Groundwater Protection, W78-00966	4B	BIRCHFIELD, G. E. The Time-Dependent Response of a Circular Basin of Variable Depth to a Wind Stress, W78-01141	2H
Free Mode Coupling of Saginaw Bay and Lake Huron, W78-01041	2H	BARKER, R. M. Summary of Geologic and Hydrologic Information Pertinent to Tunneling in Selected Urban Areas, W78-01090	8B	BODYFELT, F. W. Utilization of Cheese Whey for Wine Production, W78-01170	5E
Results from a Numerical Model for Simulating Circulation Patterns and Chlorinity Distributions in Saginaw Bay, W78-01040	2H	BARLOG, F. Treatment Plant for Effluent from the Albruck Paper Mill, W78-01121	5D	BOGGESSION, S. F. Effect of Water Stress on Proline Synthesis from Radioactive Precursors, W78-01042	2I
AMIEL, A. J. Patella Vulgata: A Biological Monitor of Coastal Metal Pollution - A Preliminary Study, W78-00906	5A	BARON, G. Unique Bit Design Improves Hydraulics and Performance, W78-00963	8C	BOMBOWNA, M. The River Skawa: Water Chemistry and Eutrophication, (In Polish), W78-00990	2K
ANDERSEN, V. M. Transition from Subcritical to Supercritical Flow, W78-00975	8B	BARRICK, D. E. Ocean Surface Currents Mapped by Radar, W78-01133	2L	BOND, M. E. The Impact of Second-Home Development on Water Availability in North Central Arizona, W78-01052	4C
ANDERSON, D. W. Water Quality Studies of Sixteen Minnesota Rivers Tributary to Lake Superior, W78-01036	5A	BARTLETT, E. S. Ammonium-Carbonate Leaching of Metal Values from Water-Treatment Sludges, W78-01166	5D	BORDERIUS, S. J. Effect of Chronic Exposure of Brook Trout to Sublethal Concentrations of Hydrogen Cyanide, W78-00915	5C
ANDERSON, J. L. Water and Chloride Movement Through Soil Columns Simulating Pedal Soils, W78-01011	2G	BASKETT, R. C. Development of an Unconventional Approach to Nitrification-Denitrification, W78-01002	5D	BORNMAN, C. H. Some Observed Interrelationships Between the Cover of Aquatic Vegetation and Various Physical Properties of the Water Medium, W78-00941	2I
ANEES, M. A. Acute Toxicity of Four Organophosphorus Insecticides to a Freshwater Teleost Channa Punctatus (Bloch), W78-00919	5C	BASU, U. Depressed Weir with Two Unequal Sheetpiles in Anisotropic Soil, W78-01151	2G	BORRONI, L. Role of Un-ionized Ammonia in Predisposing Gill Apparatus of <i>Alburnus alburnus</i> alborella to Fungal and Bacterial Diseases, W78-00918	5C

AUTHOR INDEX

BOSHOFF, H. J.

BOSHOFF, H. J.
The Influence of Fertilizer-Applied Chlorine, Chlorine Content of Irrigation Water and Leaching of Chlorine on the Uptake of Chlorine By Tobacco (In Afrikaans),
W78-00943

3F

BOTTIN, R. R. JR.
Waianae Small-Boat Harbor, Oahu, Hawaii, Design for Wave Protection, Hydraulic Model Investigation, W78-01026

8A

BOUCHER, F. B.
Pyrolysis of Industrial Wastes for Oil and Activated Carbon Recovery, W78-01172

5E

BOUMA, J.
Water and Chloride Movement Through Soil Columns Simulating Pedal Soils, W78-01011

2G

BOWES, M. D.
Improved Procedures for Valuation of the Contribution of Recreation to National Economic Development, W78-01003

6B

BOXER, S.
Elimination of Pollution from Cottage Cheese Whey by Drying and Utilization, W78-01167

5D

BOYKO, I. S.
Rainwater and Sediment Runoff from Slopes in the Azov-Kuban Plain, W78-01046

2J

BRACCHI, U.
Research on the Water Quality of the River Taro from Fornova to the Mouth (In Italian), W78-01016

5B

BRANNLAND, R.
New In-Plant Technology to Reduce Pollution from a Sodium-Base Sulfite Mill, W78-01104

5D

BREEN, C. M.
A Quantitative Sampler for Aquatic Macrophytes, W78-00929

7B

BREWSTER, F. E.
Effects of Burrowing Tubificid Worms on the Exchange of Phosphorus Between Lake Sediment and Overlying Water, W78-00921

5C

BRINK-KJAER, O.
Gravity Waves on a Current: The Influence of Vorticity, A Sloping Bed, and Dissipation, W78-01014

2E

BRISAC, J.
Unique Bit Design Improves Hydraulics and Performance, W78-00963

8C

BROCK, D. W.
Swan Mortality Due to Certain Heavy Metals in the Mission Lake Area, Idaho, W78-00903

5C

BRODERIUS, S. J.
Effect of Hydrogen Sulfide on Fish and Invertebrates Part II-Hydrogen Sulfide Determination and Relationship Between pH and Sulfide Toxicity, W78-00925

5C

BROGDEN, R. E.
Reconnaissance of Ground-Water Resources in a Part of the Yampa River Basin Between Craig and Steamboat Springs, Moffat and Routt Counties, Colorado, W78-01086

2F

BRTKO, W. J.
Pollutant Transfer into Water Bodies, W78-01019

5B

BUCKETT, J.
Fitting the Pearson Type 3 Distribution in Practice, W78-01136

2E

BURRIS, A.
Ozone: The Water Conditioning Process of the Future Today, W78-00953

5F

BUSCH, J. R.
Least Cost Irrigation System Specifications for Various Conditions, W78-00973

3F

CALLAHAN, W. F.
Physical-Chemical Treatment System at Fitchburg, Massachusetts, W78-01125

5D

CAME, D. S.
Mining Pumps for Heads in Excess of 1,500 M, W78-00930

8C

CANALE, R. P.
Short-Term Transient Variations of Limnological Parameters in Grand Traverse Bay, Lake Michigan, W78-01033

2H

CARBONNELLE, B.
Microbial Self-Purification by the Lagoon Method, (In French), W78-00910

5D

CARR, J. E.
A Preliminary Appraisal of the Garber-Wellington Aquifer, Southern Logan and Northern Oklahoma Counties, Oklahoma, W78-01075

7C

CARTER, S. A.
Fatal Disease, W78-01021

5C

CARVER, R. D.
Waianae Small-Boat Harbor, Oahu, Hawaii, Design for Wave Protection, Hydraulic Model Investigation, W78-01026

8A

CASARIU, C.
Experiments on the Optimization of Solids Recovery from Excess Recirculated Paper Mill White Water in Sveen-Pedersen Savealls (Incerari de optimizare a procesului de recuperare a materialului din apele re circulante excedentare de la fabricarea hirtiei, la recuperatorul Sveen-Pedersen), W78-00982

5D

CASTRUCCIO, P. A.
User Requirements and User Acceptance of Current and Next-Generation Satellite Mission and Sensor Complement, Oriented Toward the Monitoring of Water Resources, W78-01155

7B

CAUSEY, L. V.
Thickness of the Potable-Water Zone in the Floridan Aquifer, W78-01081

2F

CHANDA, A. J.
Filling and Emptying System, Little Goose Lock, Snake River, Washington, Hydraulic Model Investigation, W78-01061

8A

CHATHAM, C. E. JR.
Waianae Small-Boat Harbor, Oahu, Hawaii, Design for Wave Protection, Hydraulic Model Investigation, W78-01026

8A

CHEN, W.
Metal Removal and Cyanide Destruction in Plating Wastewaters Using Particle Bed Electrodes, W78-01173

5D

CHERKAUER, D. S.
Effects of Urban Lakes on Surface Runoff and Water Quality, W78-01135

2E

CHERRY, R. H. JR.
Ammonium-Carbonate Leaching of Metal Values from Water-Treatment Sludges, W78-01166

5D

CHOLET, H.
Unique Bit Design Improves Hydraulics and Performance, W78-00963

8C

CHRISTIE, N. D.
Distribution of Benthic Macrofauna in Langbeana Lagoon, W78-00999

2L

CIHLAR, J.
Microwave Remote Sensing of Soil Water Content, W78-01056

2G

COANTIC, M.
Study of Mass Transfer at the Air-Water Interface by an Isotopic Method, W78-00977

2D

COBBETT, W. G.
Bio-Treatment of Effluents with BOD Below 100 MG/Liter, W78-01109

5D

COCHRANE, M. W.
State of the Art: Wastewater Management in the Beverage Industry, W78-01168

5D

COERTZE, D. J.
Aspects of the Freshwater Mollusca of the Pongola River Flood Plain Pans, W78-01008

2E

COETZEE, J. G. K.
The Influence of Fertilizer-Applied Chlorine, Chlorine Content of Irrigation Water and Leaching of Chlorine on the Uptake of Chlorine By Tobacco (In Afrikaans), W78-00943

3F

COHEN, G. M.
Toxicities of 'Excessively' Chlorinated Organic Compounds, W78-00901

5C

COLBERT, B. K.
Environmental Inventory and Assessment of Navigation Pools 24, 25, and 26, Upper Mississippi and Lower Illinois Rivers; Summary Report, W78-01028

6G

COLE
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W78-0

AUTHOR INDEX

COLE, T. G. Dissolved Air Flotation for Combined Sewer Overflows, W78-00955	5D	DELL, C. I. Sediment Distribution and Bottom Topography of Southeastern Lake Superior, W78-01034	3F 2J	EPSTEIN, E. Water Pollution Investigation: Lower Green Bay and Lower Fox River, W78-01022	5B
COLEMAN, R. W. Catalytic Waste Treatment Systems for Great Lake Ore Carriers, W78-01157	5D	DERECKI, J. A. Multiple Estimates of Lake Erie Evaporation, W78-01035	2D	ERIKSSON, L. Instruments for the Detection of Fiber Content in Effluents and for the Classification of Recycled Fibrous Material, W78-01113	5A
CONN, A. F. Cavitating Bit Jets Promise Faster Drilling for Deep-Hole Operations, W78-00957	8C	DESAI, S. V. Dialysis for Concentration and Removal of Industrial Wastes, W78-01162	5D	EVANS, M. W. Ocean Surface Currents Mapped by Radar, W78-01133	2L
CONSTANTIN, J. M. Leather Tannery Waste Management Through Process Change, Reuse and Pretreatment, W78-01156	5D	DIAS, N. S. Temporal Changes in the Plankton of an Industrialized Estuary, W78-00914	5B	EVANS, W. E. Comparison of Different Methods for Estimating Snowcover in Forested, Mountainous Basins Using LANDSAT (ERTS) Images, W78-01095	7B
COWING, D. J. Limnological Data Report for the Maine Department of Environmental Protection - U.S. Geological Survey Cooperative Lake Studies Project, W78-01078	2H	DICKINSON, T. Rainfall Intensity-Frequency Relationships from Monthly Extremes, W78-01149	2B	EZEKIEL, S. Spectrofluorometric Differentiation of the Red Tide Alga, <i>Gonyaulax Tamarensis</i> from Other Algae Common to New England Waters, W78-00950	5C
CRAFT, C. D. A Saltwater Flow-Through Bioassay Method with Controlled Temperature and Salinity, W78-00917	5A	DOSTAL, K. A. State of the Art: Wastewater Management in the Beverage Industry, W78-01168	5D	FARRAR, C. D. Maps Showing Ground-Water Conditions in the Southern Part of the Chinle Area, Apache County, Arizona-1976, W78-01087	7C
CROW, F. R. Friction Factors for Vegetated Waterways of Small Slope, W78-01031	2E	DOUDOROFF, P. Toxicity to Fish of Cyanides and Related Compounds - A Review, W78-00927	5C	FARRELL, D. R. Ice Force Measurements on the Pembina River, Alberta, Canada, W78-01154	2C
CUNNINGHAM, G. L. Rate of Leaf Production and Senescence and Effect of Leaf Age on Net Gas Exchange in Creosotebush, W78-01054	2I	DUNIKOSKI, R. H. The Impact of Second-Home Development on Water Availability in North Central Arizona, W78-01052	4C	FERNANDEX DEL RIEGO, A. Sulfur Content of Sediments of the Marin Estuary and Other Galician Estuaries, (In Spanish), W78-00986	2K
CUSHING, E. M. Summary of Geologic and Hydrologic Information Pertinent to Tunneling in Selected Urban Areas, W78-01090	8B	DUNLAP, W. J. Environmental Effects of Septic Tank Systems, W78-00967	5B	FERRIS, C. Environmental Inventory and Assessment of Navigation Pools 24, 25, and 26, Upper Mississippi and Lower Illinois Rivers; Summary Report, W78-01028	6G
D'LUGOSZ, J. J. Hydrologic Data for the Vamoosa Aquifer, East-Central Oklahoma, W78-01076	2A	DWYER, J. F. Improved Procedures for Valuation of the Contribution of Recreation to National Economic Development, W78-01003	6B	FIELDS, D. E. Hydrologic and Chemical Budgets on Walker Branch Watershed-Observations and Modeling Applications, W78-01071	2A
DALRYMPLE, R. A. A Mechanism for Rip Current Generation on an Open Coast, W78-00976	2L	DYER, T. G. J. Solar Activity and Rainfall Variation Over Southern Africa, W78-00939	2B	FINDER, E. E. Continuous Chlorination of Contaminated Water, W78-00971	5D
DAVIS, R. B. Effects of Burrowing Tubificid Worms on the Exchange of Phosphorus Between Lake Sediment and Overlying Water, W78-00921	5C	EAGLEMAN, J. R. Detection of Soil Moisture and Soil Characteristics from Skylab, W78-01058	7B	FISCHBACH, P. E. Protection of a Unique Ecological Area Through Improved Water and Fertility Management, W78-01001	2G
DAVIS, S. J. Quantitative Studies on Marine Biodegradation of Oil, III. Comparison of Different Crude Oil Residues and Effects of Sea Water Source, W78-00907	5C	EARHART, J. P. Extraction of Chemical Pollutants from Industrial Wastewaters with Volatile Solvents, W78-01171	5D	FISHER, L. R. JR. Total Water System (AT) Coshocton Mill (OF) Stone Container Corporation, W78-01124	3E
DAY, T. J. Observed Mixing Lengths in Mountain Streams, W78-01150	2E	ECKSTEIN, N. A. Effluent Quality Improvement in a Bleached Kraft Pulp Mill, W78-01107	5D	FISHER, W. S. Egg Mortalities in Wild Populations of the Dungeness Crab in Central and Northern California, W78-00902	5C
DE BRUYN, L. P. The Influence of Certain Cultivation Practices on the Growth and Production of Zea Mays in Marginal Areas (In Afrikaans), W78-00947	3F	ELEY, R. L. Application of Ecosystem Modeling Methodologies to Dredged Material Research, W78-01070	5A	FOURIE, H. O. Trace Element Concentrations in Marine Organisms from the Cape West Coast, W78-00937	5B

AUTHOR INDEX

FOURIE, J. P.

FOURIE, J. P.
Implementation of Field Layout for Mechanization and Surface Water Control, W78-00942 4A

FOWLER, T. R.
User Requirements and User Acceptance of Current and Next-Generation Satellite Mission and Sensor Complement, Oriented Toward the Monitoring of Water Resources, W78-01155 7B

FUJII, T.
Measurement of Periodic Open and Shut Shell Movement of Bivalves by the Strain-Gauge Method, W78-00911 7B

FUJIYAMA, T.
Content and Uptake of Trace Metals in Benthic Algae, Enteromorpha and Porphyra I. Measurement and Variation of Trace Metal Content of Porphyra Grown in Natural Environment, W78-00908 5B

Content and Uptake of Trace Metals in Benthic Algae, Enteromorpha and Porphyra II. Studies on the Algae Cultured in Sea Water Supplemented with Various Metals, W78-00924 5B

FURNESS, H. D.
A Quantitative Sampler for Aquatic Macrophytes, W78-00929 7B

GABICA, J.
Swan Mortality Due to Certain Heavy Metals in the Mission Lake Area, Idaho, W78-00903 5C

GABRIEL, P. L.
Temporal Changes in the Plankton of an Industrialized Estuary, W78-00914 5B

GARDNER, F. H. JR.
Naval Stores Wastewater Purification and Reuse by Activated Carbon Treatment, W78-01160 5D

GASS, T. E.
Gass on Gas, W78-00956 2F

Impact of Abandoned Wells on Ground Water, W78-00968 6E

Removing Iron from a Water Supply, W78-00954 5F

Well Redevelopment: Part II, W78-00952 3B

GAUDET, J. P.
Solute Transfer, with Exchange Between Mobile and Stagnant Water, Through Unsaturated Sand, W78-01065 2G

GEERTSEMA, F. K.
Tests on Sprinklers (In Afrikaans), W78-00944 3F

GELLMAN, I.
Results of an NCASI Pilot Plant Study of Mechanical Dewatering Alternatives for Waste Activated Sludge, W78-01123 5D

GIBBS, C. F.
Quantitative Studies on Marine Biodegradation of Oil, III. Comparison of Different Crude Oil Residues and Effects of Sea Water Source, W78-00907 5C

GILES, T. F.
Reconnaissance of Ground-Water Resources in a Part of the Yampa River Basin Between Craig and Steamboat Springs, Moffat and Routt Counties, Colorado, W78-01086 2F

GIUSSANI, G.
Role of Un-ionized Ammonia in Predisposing Gill Apparatus of *Alburnus alburnus alborella* to Fungal and Bacterial Diseases, W78-00918 5C

GIUSTI, E. V.
Water Consumption by Nuclear Powerplants and Some Hydrological Implications, W78-01097 7C

GOLDSMITH, R. L.
Reverse Osmosis Field Test: Treatment of Watts Nickel Rinse Waters, W78-01161 5D

GOLLAN, A. Z.
Reverse Osmosis Field Test: Treatment of Watts Nickel Rinse Waters, W78-01161 5D

GOOLSBY, D. A.
Nitrogen Loads and Concentrations in Florida Streams, W78-01082 7C

GREEN, A. W.
Free Mode Coupling of Saginaw Bay and Lake Huron, W78-01041 2H

Results from a Numerical Model for Simulating Circulation Patterns and Chlorinity Distributions in Saginaw Bay, W78-01040 2H

GRIFFITHS, G. A.
Separation and Reuse of Waste Solids from Liquid Effluents, W78-01112 5D

GRIMALDI, E.
Role of Un-ionized Ammonia in Predisposing Gill Apparatus of *Alburnus alburnus alborella* to Fungal and Bacterial Diseases, W78-00918 5C

GRIMAS, ULF.
Ecological Aspects of Cooling Water Discharges. (In Swedish), W78-00922 5C

GRUNOW, J. O.
Some Observed Interrelationships Between the Cover of Aquatic Vegetation and Various Physical Properties of the Water Medium, W78-00941 2I

GUENTHER, A. H.
The Activity of Trace Metals in Aqueous Systems and the Effect of Corrosion Control Inhibitors, W78-01057 8G

GUNNETT, J. W.
Feasibility of Elk Creek Acid Mine Drainage Abatement Project, W78-01159 5D

GUSTAFSSON, R.
New In-Plant Technology to Reduce Pollution from a Sodium-Base Sulfite Mill, W78-01104 5D

GUSTARD, A.
A Study Into the Low-Flow Characteristics of British Rivers, W78-01148 2E

HAJELA, G. P.
Metal Removal and Cyanide Destruction in Plating Wastewaters Using Particle Bed Electrodes, W78-01173 5D

HALL, R. W.
Application of Ecosystem Modeling Methodologies to Dredged Material Research, W78-01070 5A

HALLOWELL, J. B.
Ammonium-Carbonate Leaching of Metal Values from Water-Treatment Sludges, W78-01166 5D

HATTORI, S.
Follow-Up Investigation on Cyanide Complex Detected from Pulp Sludge (Seisi suragi kara kenshutsu sareta shian kagobutsu ni tsuite no tsuiseki chosa), W78-01174 5B

HAYNES, F. D.
Ice Force Measurements on the Pembina River, Alberta, Canada, W78-01154 2C

HEALY, H. G.
Public Water Supplies of Selected Municipalities in Florida, 1975, W78-01098 6D

HEISS, H. W. JR.
Impact of Abandoned Wells on Ground Water, W78-00968 6E

HELLIWELL, P. R.
Simulation of the Inlet Hydrograph for Urban Catchments, W78-01147 2E

HELM, D. C.
Ground-Water Resources of the Lower Santiam River Basin, Middle Willamette Valley, Oregon, W78-01084 4B

HENDERSON, G. S.
Hydrologic and Chemical Budgets on Walker Branch Watershed-Observations and Modeling Applications, W78-01071 2A

HENSON, B. L.
The Interrelationships of the Longitudinal Profiles and Channel Pattern for the Red River, W78-01146 2E

HEPP, H.
The Adsorptive Purification of Effluents with Granular Activated Alumina (Die adsorptive Reinigung von Abwaessern mit gekoernter Aktivtonerde), W78-01182 5D

HERNANDEZ, J. W.
Underground Injection Program Set Under Safe Drinking Water Act, W78-00955 6E

AUTHOR INDEX

KING, C. J.

HESS, J. J.
Treatment System is Innovative for Coal Storage Facility, W78-01074 5D

HEY, R. D.
Direct Measurements of Secondary Currents in River Bends, W78-01067 2E

HEYNS, J.
Preliminary Results of a Survey of Freshwater Nematodes in South Africa, W78-01005 5C

HICKIE, B. P.
The Time-Dependent Response of a Circular Basin of Variable Depth to a Wind Stress, W78-01141 2H

HILL, J.
Instruments for the Detection of Fiber Content in Effluents and for the Classification of Recycled Fibrous Material, W78-01113 5A

HILL, S. J.
Separation and Reuse of Waste Solids from Liquid Effluents, W78-01112 5D

HILLSTROM, R.
Process Concepts for Oxygen Delignification, W78-01106 5D

HINES, W. G.
Hydrologic Analysis and River-Quality Data Programs, W78-01079 7A

HIRSCH, R. M.
Comparative Assessment of Water Use and Environmental Implications of Coal Slurry Pipelines, W78-01085 8A

HISTED, J. A.
Lime Treatment of Bleachery Effluent, W78-01110 5D

HODGINS, B.
Installation, Operation and Maintenance of Vertical Turbine Pumps, W78-00961 8C

HOFFER, R. M.
Computer-Aided Analysis of Skylab Multispectral Scanner Data in Mountainous Terrain for Land Use, Forestry, Water Resource, and Geologic Applications, W78-01059 7B

HOLMGREN, S. H.
Phytoplankton, Phytoplankton Growth and Biomass Cycles in an Unpolluted and in a Polluted Polar Lake, W78-00920 5C

HOSOYA, S.
Studies on Low Molecular Weight Compounds in Kraft Bleaching Liquor (In Japanese), W78-01117 5A

HULTMAN, B.
New In-Plant Technology to Reduce Pollution from a Sodium-Base Sulfite Mill, W78-01104 5D

HUMAN, J. J.
The Influence of Certain Cultivation Practices on the Growth and Production of *Zea Mays* in Marginal Areas (In Afrikaans), W78-00947 3F

KABEL, R. L.
Pollutant Transfer into Water Bodies, W78-01019 5B

KAIM-MALKA, R. A.
Recent Evolution of the Different Levels of Marine Pollution of the Soft Substratum Linked with the Big Sewer of Marseille-Corbiou. (In French), W78-01015 5C

KALIFF, J.
The Periods Sensitive to Internal Plant Moisture Stress During Growth and Development of *Zea Mays* (In Afrikaans), W78-00948 3F

HUMENIK, F. J.
State-of-the-Art: Swine Waste Production and Pretreatment Processes, W78-01169 5D

HUTCHISON, I. P.
Lake St. Lucia: Mathematical Modelling and Evaluations of Ameliorative Measures, W78-01006 2H

INMAN, D. L.
Vortex Generation by Oscillatory Flow Over Rippled Surfaces, W78-00979 2L

JAMES, I. C. II
Comparative Assessment of Water Use and Environmental Implications of Coal Slurry Pipelines, W78-01085 8A

JAMIESON, A.
Process Concepts for Oxygen Delignification, W78-01106 5D

JEGAT, H.
Solute Transfer, with Exchange Between Mobile and Stagnant Water, Through Unsaturated Sand, W78-01065 2G

JELENIC, D.
Study of the Influence of Soil Drought and High Air Temperature on Some Physiological Processes in Maize Plant (In Serbo-Croatian), W78-01018 2I

JENNINGS, A. C.
Aspects of the Freshwater Mollusca of the Pongola River Flood Plain Pans, W78-01008 2E

JOHNS, B.
Residual Flow and Boundary Shear Stress in the Turbulent Bottom Layer Beneath Waves, W78-01139 2L

JOHNSON, D. R.
Density-Induced Motions in Shallow Lagoons, W78-00951 2L

JOHNSTON, N. A.
Implementation of Field Layout for Mechanization and Surface Water Control, W78-00942 4A

JOYCE, M. E.
State of the Art: Wastewater Management in the Beverage Industry, W78-01168 5D

JURIS, S.
Contribution to the Phytoplankton of the Bakanske Rameno, A Tributary of the Danube River (In Czech), W78-01116 5C

KANELETZ, M.
Treatment System is Innovative for Coal Storage Facility, W78-01074 5D

KATZ, B. M.
Toxicities of 'Excessively' Chlorinated Organic Compounds, W78-00901 5C

KEENER, P. M.
Start-up and Operating Experience with a Twin Wire Moving Belt Press for Primary Sludge, W78-01129 5D

KELLY, J. R.
Improved Procedures for Valuation of the Contribution of Recreation to National Economic Development, W78-01003 6B

KELLY, T. M.
Short-Term Transient Variations of Limnological Parameters in Grand Traverse Bay, Lake Michigan, W78-01033 2H

KELLY, W. E.
Electrical Resistivity for Estimating Permeability, W78-01010 2F

KENNEDY, J. P.
Cenozoic Evolution of Antarctic Glaciation, the Circum-Antarctic Ocean, and Their Impact on Global Paleoceanography, W78-01138 2L

KERECKI, B.
Study of the Influence of Soil Drought and High Air Temperature on Some Physiological Processes in Maize Plant (In Serbo-Croatian), W78-01018 2I

KERFOOT, B.
Spectrofluorometric Differentiation of the Red Tide Alga, *Gonyaulax Tamarensis* from Other Algae Common to New England Waters, W78-00950 5C

KESSENICH, T. A.
IFYGL Shipboard Visual Wave Observations vs Wave Measurements, W78-01039 2H

KIDD, C. H. R.
Simulation of the Inlet Hydrograph for Urban Catchments, W78-01147 2E

KIKUCHI, T.
Residue Analyses on 2-Amino-4-phenylthiazole, a Fisine Anesthetic, in Fishes - III Metabolism in Rainbow Trout and Carp, W78-00923 5A

KING, C. J.
Extraction of Chemical Pollutants from Industrial Wastewaters with Volatile Solvents, W78-01171 5D

AUTHOR INDEX

KING, R. D.

KING, R. D.
A Simple Portable Vacuum Pump,
W78-00931 5A

KIRSCHTEN, J. D.
Draining the Water Projects Out of the Pork
Barrel,
W78-01045 4A

Turning Back the Tides of Long-Time Federal
Water Policy,
W78-01044 6E

KLATTENBERG, R. P.
A Plexiglass Subsampling Box for Large
Benthos Samples,
W78-00913 7B

KLEIN, E.
Dialysis for Concentration and Removal of In-
dustrial Wastes,
W78-01162 5D

KLEMAS, V.
Analysis of Inhomogeneous Wave Number
Spectra,
W78-00978 2L

KLING, H. J.
Phytoplankton, Phytoplankton Growth and
Biomass Cycles in an Unpolluted and in a Pol-
luted Polar Lake,
W78-00920 5C

KNELL, E. W.
Pyrolysis of Industrial Wastes for Oil and Ac-
tivated Carbon Recovery,
W78-01172 5E

KNIGHT, A. L.
Water and Related Problems in Coal-Mine
Areas of Alabama,
W78-01094 5B

KNOLL, R. H.
Analysis of a Solar Collector Field Water Flow
Network,
W78-01032 8B

KOENST, W. M.
Effect of Chronic Exposure of Brook Trout to
Sublethal Concentrations of Hydrogen Cya-
nide,
W78-00915 5C

KOHLMEYER, S. I.
Nitrogen Yield Coefficient of the Green Alga,
Seleniastrum Capricornutum Printz,
W78-01000 5C

KOMAR, P. D.
Threshold of Sediment Motion Under Un-
directional Currents,
W78-01030 2J

KREISSEL, J. F.
Environmental Effects of Septic Tank
Systems,
W78-00967 5B

KRISHNAMURTHI, N.
Mathematical Modeling of Natural Ground-
water Recharge,
W78-00974 2F

KRONFELD, J.
Patella Vulgata: A Biological Monitor of
Coastal Metal Pollution - A Preliminary Study,
W78-00906 5A

KRUGER, J. A.
Quantitative Map Interpretation in Regional
Planning Surveys (In Afrikaans),
W78-00934 7C

KUDRYAVTSEV, V. M.
Microbiological Processes in the Meromictic
Lake Valle de San Juan in Cuba (In Russian),
W78-01180 2H

KUZNETSOV, N. T.
Calcium Carbonates in Suspended Deposits of
Rivers and Irrigation Systems in Central Asia
(In Russian),
W78-01072 2J

LAKOMSKI, P. E.
Catalytic Waste Treatment Systems for Great
Lake Ore Carriers,
W78-01157 5D

LANDNER, L.
Eutrophication of Lakes,
W78-01020 5C

LANDREY, O. P.
Implementation of Field Layout for
Mechanization and Surface Water Control,
W78-00942 4A

LANG, E. W.
Color Increase of Treated Kraft Mill Effluents,
W78-01131 5D

LARSON, P. K.
Utilization of Cheese Whey for Wine Produc-
tion,
W78-01170 5E

LAZAYRES, R.
Unique Bit Design Improves Hydraulics and
Performance,
W78-00963 8C

LEACH, J. M.
Detoxification of Bleached Kraft Mill Effluents
- A Manageable Problem,
W78-01127 5D

LEBSKA, B.
Ascorbimetric Determination of Oxygen Con-
tent in Water (Askorbimetryczna metoda oznacza-
nia zawartości tlenu w wodzie),
W78-01119 5A

LECLERC, H.
Microbial Self-Purification by the Lagoon
Method, (In French),
W78-00910 5D

LEE, E. G-H.
Analysis and Characterization of Suspended
Solids in Pulp and Paper Mill Effluent,
W78-01102 5A

LEE, L. J.
The Interrelationships of the Longitudinal
Profiles and Channel Pattern for the Red River,
W78-01146 2E

LEE, T. N.
Density-Induced Motions in Shallow Lagoons,
W78-00951 2L

LEHR, J. H.
Impact of Abandoned Wells on Ground Water,
W78-00968 6E

LEMIRE, R. S.
Water Quality Studies of Sixteen Minnesota
Rivers Tributary to Lake Superior,
W78-01036 5A

LEONARD, A. R.
Ground-Water Resources of the Lower San-
tiam River Basin, Middle Willamette Valley,
Oregon,
W78-01084 4B

LESZCZYNSKI, C.
Effect of Various Technological Factors on the
Color of Pulp Mill Effluents (Wpływ rożnych
czynników technologicznych na barwę ścieków
pocelulozowych),
W78-00989 5B

LEVE, G. W.
Thickness of the Potable-Water Zone in the
Florida Aquifer,
W78-01081 2F

LEVINGS, G. W.
Maps Showing Ground-Water Conditions in the
Southern Part of the Chinle Area, Apache
County, Arizona--1976,
W78-01087 7C

LEYDEN, R. F.
Cost Comparison of Drip and Flood Irrigations
Systems,
W78-01048 3F

LIANG, S. S.
Mechanics of Suspended Sediment in Random
Waves,
W78-00980 2L

LILLIG, C.
A Quantitative Sampler for Aquatic
Macrophytes,
W78-00929 7B

LINDQVIST, B.
Process Concepts for Oxygen Delignification,
W78-01106 5D

LIU, P. C.
IFYGL Shipboard Visual Wave Observations
vs Wave Measurements,
W78-01039 2H

LOATS, H. L.
User Requirements and User Acceptance of
Current and Next-Generation Satellite Mission
and Sensor Complement, Oriented Toward the
Monitoring of Water Resources,
W78-01155 7B

LOCKETT, C. A.
Juvenile Fish Populations in the Marginal Areas
of Lake McIlwaine, Rhodesia,
W78-01007 2H

LONG, C. W.
Use of Salt (NaCl) Water to Reduce Mortality
of Chinook Salmon Smolts, *Oncorhynchus*
Tshawytscha, During Handling and Hauling,
W78-00909 5G

LONGENBAUGH, R. A.
Mathematical Modeling of Natural Ground-
water Recharge,
W78-00974 2F

LOOMIS, M.
Swan Mortality Due to Certain Heavy Metals
in the Mission Lake Area, Idaho,
W78-00903 5C

LOY, L. D. JR.
Feasibility of Elk Creek Acid Mine Drainage
Abatement Project,
W78-01159 5D

AUTHOR INDEX

MOLDAN, A.

LUQUE, R. F.
Erosion and Transport of Bed-Load Sediment, W78-01060 2J

LYSHEDE, O. B.
Structure of the Epidermal and Subepidermal Cells of Some Desert Plants of Israel, *Anabasis Articulata* and *Calligonum Comosum*, W78-01053 2I

MAEDA, M.
Content and Uptake of Trace Metals in Benthic Algae, Enteromorpha and Porphyra I. Measurement and Variation of Trace Metal Content of Porphyra Grown in Natural Environment, W78-00908 5B

Content and Uptake of Trace Metals in Benthic Algae, Enteromorpha and Porphyra II. Studies on the Algae Cultured in Sea Water Supplemented with Various Metals, W78-00924 5B

MALLAN, G. M.
Pyrolysis of Industrial Wastes for Oil and Activated Carbon Recovery, W78-01172 5E

MANN, T.
Waste-Water Treatment: Ecological, Technological and Economic Aspects (In German), W78-01163 5D

MANNISTO, H.
Energy vs. Environment -- Friends or Foes, W78-01103 5D

MARCHER, M. V.
A Preliminary Appraisal of the Garber-Wellington Aquifer, Southern Logan and Northern Oklahoma Counties, Oklahoma, W78-01075 7C

MARKHAM, C. G.
Pacific Sea-Surface Temperature Related to Rain in California, W78-01066 2B

MARSHALL, B. E.
Juvenile Fish Populations in the Marginal Areas of Lake McIlwaine, Rhodesia, W78-01007 2H

MARSHALL, D. W.
Results of an NCASI Pilot Plant Study of Mechanical Dewatering Alternatives for Waste Activated Sludge, W78-01123 5D

MARTIN, H. W.
Water Pollution Caused by Inactive Ore and Mineral Mines - A National Assessment, W78-01158 5B

MATZKE, W. H.
Disposal and Recycling of Rejects from Waste Paper and Closed Water Systems, W78-01114 3E

MCANEAR, C. L.
Three-Dimensional Seepage Model Study Oakley Dam, Sangamon River, Illinois, W78-01068 8B

MCCARTNEY, B. L.
Stability of Gobi Block Revetment to Wave Attack, W78-01027 8F

MCCAVER, I. N.
Threshold of Sediment Motion Under Unidirectional Currents, W78-01030 2J

MCCLAFLIN, R. G.
Hydrologic Data for the Vamoosa Aquifer, East-Central Oklahoma, W78-01076 2A

MCCOMAS, J. R.
Use of Salt (NaCl) Water to Reduce Mortality of Chinook Salmon Smolts, *Oncorhynchus Tshawytscha*, During Handling and Hauling, W78-00909 5G

MCEVOY, J.
Water Pollution Investigation: Lower Green Bay and Lower Fox River, W78-01022 5B

MCFADDEN, T.
1974 Ice Breakup on the Chena River, W78-01013 2C

MCKAGUE, A. B.
Floculating Agents Derived from Kraft Lignin, W78-00988 5D

MCKENZIE, S. W.
Analysis of Street Sweepings, Portland, Oregon, W78-01077 5A

Hydrologic Analysis and River-Quality Data Programs, W78-01079 7A

MCLAIN, D. R.
Pacific Sea-Surface Temperature Related to Rain in California, W78-01066 2B

MCLEESE, D. W.
Fenitrothion Toxicity to the Freshwater Crayfish, *Orconectes limosus*, W78-00904 5C

MCNULTY, K. J.
Reverse Osmosis Field Test: Treatment of Watts Nickel Rinse Waters, W78-01161 5D

MCPHEE, P. J.
Soil Survey Interpretations for Earth Dams, W78-00938 8D

MEADE, T. L.
The Influence of Ammonia on the Oxygen Delivery System of Coho Salmon Hemoglobin, W78-00916 5C

MEDHI, J.
A Markov Chain Model for the Occurrences of Dry and Wet Days, W78-01143 2B

MEIER, M. F.
Comparison of Different Methods for Estimating Snowcover in Forested, Mountainous Basins Using LANDSAT (ERTS) Images, W78-01095 7B

MEISLER, H.
Summary of Ground-Water Conditions in the Jaffna Peninsula, Republic of Sri Lanka, With a Plan for Investigating Feasibility of Ground-Water Development, W78-01093 4B

MELAUGH, J. F.
Downhole Drilling Motor Creates High Torque at Low Speeds, W78-00964 8C

MERCER, J. H.
Radiocarbon Dating of the Last Glaciation in Peru, W78-01009 2C

MERLIVAT, L.
Study of Mass Transfer at the Air-Water Interface by an Isotopic Method, W78-00977 2D

METZGER, L. R.
Start-up and Operating Experience with a Twin Wire Moving Belt Press for Primary Sludge, W78-01129 5D

MEYER, E. L.
Water Consumption by Nuclear Powerplants and Some Hydrological Implications, W78-01097 7C

MILICHOVSKY, M.
Chemical Agents Used in the Effluent Treatment Plant (Pomocne chemicke prostredky v cisternu odpadnick vod), W78-00967 5D

MILLER, M. C.
Threshold of Sediment Motion Under Unidirectional Currents, W78-01030 2J

MILLER, R. L.
Color Increase of Treated Kraft Mill Effluents, W78-01131 5D

MILLER, T. L.
Analysis of Street Sweepings, Portland, Oregon, W78-01077 5A

MILLETARI, A. F.
Sampling of Industrial Wastewater Helps Meet Discharge Standards, W78-01073 7B

MILLS, W. R. JR.
Water Pollution Caused by Inactive Ore and Mineral Mines - A National Assessment, W78-01158 5B

MINAS, M.
Dissolved Oxygen and Saturation in an Environment of High Organic Production (Etang De Berre): Role of Halocline on Distribution of These and on the Oxygen-Phosphate Ratio (In French), W78-00935 2L

MINER, R. A.
Results of an NCASI Pilot Plant Study of Mechanical Dewatering Alternatives for Waste Activated Sludge, W78-01123 5D

MISHRA, A. P.
Effects of Aquifer Thickness and Side Perforation on Discharge from Open Well, W78-00962 2F

MOELLER, D. J.
Water Quality Protection at the (Simpson Paper Company) Shasta Mill, W78-01130 5D

MOLDAN, A.
Distribution of Benthic Macrofauna in Langbaan Lagoon, W78-00999 2L

AUTHOR INDEX

MOLL, R. A.

MOLL, R. A.
Distribution of Water Masses in and Near the Straits of Mackinac, W78-01038 2H

MONK, B. H.
Use of Salt (NaCl) Water to Reduce Mortality of Chinook Salmon Smolts, *Oncorhynchus tshawytscha*, During Handling and Hauling, W78-00909 5G

MOORE, R. K.
Detection of Soil Moisture and Soil Characteristics from Skylab, W78-01058 7B

MOORE, S. E.
Catalytic Waste Treatment Systems for Great Lake Ore Carriers, W78-01157 5D

MORCH, K. A.
Utilization of Solids from Waste Water Treatment Plants in Board Manufacture, W78-01115 5D

MUELLER, J. C.
Analysis and Characterization of Suspended Solids in Pulp and Paper Mill Effluent, W78-01102 5A

MUKHERJEE, A. K.
Monsoon in Sierra Leone, W78-01145 2B

MURRAY, F. W.
Computations with the Rand Cloud Model for the Hplex Workshop, June 1975, W78-01063 2B

MUSIL, C. F.
Some Observed Interrelationships Between the Cover of Aquatic Vegetation and Various Physical Properties of the Water Medium, W78-00941 2I

MUTREJA, K. N.
Reservoir Capacity for Periodic-Stochastic Input and Periodic Output, W78-01012 4A

NAGAI, T.
Follow-Up Investigation on Cyanide Complex Detected from Pulp Sludge (Seisi suragi kara kenshutsu sareta shian kagobutsu ni tsuite no tsuiseki chosa), W78-01174 5B

NAGANO, T.
Follow-Up Investigation on Cyanide Complex Detected from Pulp Sludge (Seisi suragi kara kenshutsu sareta shian kagobutsu ni tsuite no tsuiseki chosa), W78-01174 5B

NAKANO, J.
Studies on Low Molecular Weight Compounds in Kraft Bleaching Liquor (In Japanese), W78-01117 5A

NAVROT, J.
Water Quality Protection at the (Simpson Paper Company) Shasta Mill, W78-01130 5D

NAVRAT, J.
Patella Vulgata: A Biological Monitor of Coastal Metal Pollution - A Preliminary Study, W78-00906 5A

NAYAK, K. V.
Lime Treatment of Bleachery Effluent, W78-01110 5D

NECULAU, G.
Considerations and Possibilities of Optimizing the Water Circuits of the Braila Pulp and Paper Mill (Considerari si posibilitati privind optimizarea circuitelor apelor de fabricatie la C.C.H.-Braila), W78-00985 3E

NEL, P. C.
The Role of Water Nutrition and Yield Level in the Grain-Stalk Ratio of Maize (In Afrikaans), W78-00946 3F

NELSON-SMITH, A.
Temporal Changes in the Plankton of an Industrialized Estuary, W78-00914 5B

NEUSTADTER, H. E.
Meteorological Adjustment of Yearly Mean Values for Air Pollutant Concentration Comparisons, W78-01153 2B

NEVEL, D. E.
Ice Force Measurements on the Pembina River, Alberta, Canada, W78-01154 2C

NEWTON, J. G.
Water and Related Problems in Coal-Mine Areas of Alabama, W78-01094 5B

NICOLLE, F. M. A.
Lime Treatment of Bleachery Effluent, W78-01110 5D

NIMMO, D. R.
A Saltwater Flow-Through Bioassay Method with Controlled Temperature and Salinity, W78-00917 5A

NOVOTNY, C. J.
Innovative Rinse-and-Recovery System for Metal Finishing Processes, W78-01165 5D

OJHA, T. P.
Effects of Aquifer Thickness and Side Perforation on Discharge from Open Well, W78-00962 2F

OLIVER, F. R.
Fitting the Pearson Type 3 Distribution in Practice, W78-01136 2E

OLIVER, J.
A Quantitative Sampler for Aquatic Macrophytes, W78-00929 7B

ORIVUORI, J.
Waste Heat for Evaporation of Effluents, W78-01105 5D

OVERCASH, M. R.
State-of-the-Art: Swine Waste Production and Pretreatment Processes, W78-01169 5D

PALACIOS, M. O.
Radiocarbon Dating of the Last Glaciation in Peru, W78-01009 2C

PALEG, L. G.
Effect of Water Stress on Proline Synthesis from Radioactive Precursors, W78-01042 2I

PALMER, R. N.
Comparative Assessment of Water Use and Environmental Implications of Coal Slurry Pipelines, W78-01085 8A

PARKER, W. H. III
Environmental Impact Assessments for U.S. and Canadian Industries, W78-01099 5C

PARMENTER, J.
Analysis of Street Sweepings, Portland, Oregon, W78-01077 5A

PARSONS, D. R.
Environmental Inventory and Assessment of Navigation Pools 24, 25, and 26, Upper Mississippi and Lower Illinois Rivers; Summary Report, W78-01028 6G

PATRIE, B. A.
Environmental Impact Assessments for U.S. and Canadian Industries, W78-01099 5C

PATTERSON, D. J.
Water Pollution Investigation: Lower Green Bay and Lower Fox River, W78-01022 5B

PEEPLES, M. L.
Development of an Unconventional Approach to Nitrification-Denitrification, W78-01002 5D

PENCIC, M.
Study of the Influence of Soil Drought and High Air Temperature on Some Physiological Processes in Maize Plant (In Serbo-Croatian), W78-01018 2I

PENNIMAN, J. G.
New State-of-the-Art Automatic Microelectrophoresis Instrumentation, W78-01132 5A

PENZAR, B.
Assessment of Dryness and Wetness Based on Precipitation, Water Supply in the Soil and Potential Evapotranspiration (In Serbo-Croatian), W78-01017 2B

PENZAR, I.
Assessment of Dryness and Wetness Based on Precipitation, Water Supply in the Soil and Potential Evapotranspiration (In Serbo-Croatian), W78-01017 2B

PERES EIRIS, M.
Microbiological Processes in the Meromictic Lake Valle de San Juan in Cuba (In Russian), W78-01180 2H

PERKINS, L. Z.
Filling and Emptying System, Little Goose Lock, Snake River, Washington, Hydraulic Model Investigation, W78-01061 8A

PETRESCU, C.
Considerations and Possibilities of Optimizing the Water Circuits of the Braila Pulp and Paper

AUTHOR INDEX

SCOTNEY, D. M.

Mill (Consideratii si posibilitati privind optimizarea circuitelor apelor de fabricatie la C.C.H.-Braila),
W78-00985 3E

PICARD, J.
Recent Evolution of the Different Levels of Marine Pollution of the Soft Substratum Linked with the Big Sewer of Marseille-Cor-tiou. (In French),
W78-01015 5C

PINCINCE, A. B.
Physical-Chemical Treatment System at Fitchburg, Massachusetts,
W78-01125 5D

PITCHFORD, R. J.
The Effect of Large Dams on River Water Temperature Below the Dams, with Special Reference to Bilharzia and the Verwoerd Dam,
W78-00997 6G

PITMAN, W.
Lake St. Lucia: Mathematical Modelling and Evaluations of Ameliorative Measures,
W78-01006 2H

POGGE, E. C.
Detection of Soil Moisture and Soil Characteristics from Skylab,
W78-01058 7B

POPA, V.
Considerations and Possibilities of Optimizing the Water Circuits of the Braila Pulp and Paper Mill (Consideratii si posibilitati privind optimizarea circuitelor apelor de fabricatie la C.C.H.-Braila),
W78-00985 3E

POPOVICI, A.
Experiments on the Optimization of Solids Recovery from Excess Recirculated Paper Mill White Water in Sveen-Pedersen Sawmills (Incerari de optimizare a procesului de recuperare a materialului din apele re circulatice excedentare de la fabricarea hirtiei, la recuperatorul Sveen-Pedersen),
W78-00982 5D

PRAHACS, S.
Treatment of Pulp and Paper Mill Effluents Using Physical-Chemical Techniques,
W78-01111 5D

PRAUSNITZ, J. M.
Extraction of Chemical Pollutants from Industrial Wastewaters with Volatile Solvents,
W78-01171 5D

PRESTON, G. T.
Pyrolysis of Industrial Wastes for Oil and Activated Carbon Recovery,
W78-01172 5E

PRETORIUS, S. J.
Aspects of the Freshwater Mollusca of the Pongola River Flood Plain Pans,
W78-01008 2E

PUGH, K. B.
Quantitative Studies on Marine Biodegradation of Oil, III. Comparison of Different Crude Oil Residues and Effects of Sea Water Source,
W78-00907 5C

QUINN, F. H.
Detroit River Flow Characteristic and Their Application to Chemical Loading Estimates,
W78-01037 2E

RADHAKRISHNAN, V.
A High-Resolution Electronic Rainfall Intensity Recorder and Totaliser,
W78-01142 2B

RADTKE, R. P.
Cavitating Bit Jets Promise Faster Drilling for Deep-Hole Operations,
W78-00957 8C

RAMSEY, R. H. III.
Development of an Unconventional Approach to Nitritation-Denitrification,
W78-01002 5D

RARIDON, R. J.
Hydrologic and Chemical Budgets on Walker Branch Watershed-Observations and Modeling Applications,
W78-01071 2A

RATHWELL, P. J.
Cost Comparison of Drip and Flood Irrigations Systems,
W78-01048 3F

RECHT, H. L.
Metal Removal and Cyanide Destruction in Plating Wastewaters Using Particle Bed Electrodes,
W78-01173 5D

REDDY, A. S.
Depressed Weir with Two Unequal Sheetpiles in Anisotropic Soil,
W78-01151 2G

REE, W. O.
Friction Factors for Vegetated Waterways of Small Slope,
W78-01031 2E

REICHENBAUGH, R. C.
A Hydrologic Description of Keystone Lake Near Tampa, Florida,
W78-01088 2H

REID, R. O.
An Analysis of Drag Coefficient at Hurricane Windspeeds from a Numerical Simulation of Dynamical Water Level Changes in Lake Okeechobee, Florida,
W78-01023 2H

RICKERT, D. A.
Hydrologic Analysis and River-Quality Data Programs,
W78-01079 7A

RINELLA, J. F.
Analysis of Street Sweepings, Portland, Oregon,
W78-01077 5A

Lakes of Oregon: Volume 5. Marion County,
W78-01080 2H

RISK, M. J.
Relationships Between the Bivalve Macoma Balthica and Bacteria in Intertidal Sediments: Minas Basin, Bay of Fundy,
W78-00905 5C

ROBERTS, B. R.
The Effect of Seasonal Grazing on the Infiltration Capacity of Soils in a Cymbopogon-Themeda Veld (In Afrikaans),
W78-00949 2G

ROBINSON, P.
User Requirements and User Acceptance of Current and Next-Generation Satellite Mission

and Sensor Complement, Oriented Toward the Monitoring of Water Resources,
W78-01155 7B

RODEAUD, J.
Adjustments and Innovation in a French Paper Mill (Adjustements et innovations dans une papeterie francaise),
W78-01101 5D

RODLAND, G.
Chemical Precipitation and Sedimentation of Wallboard Mill Waste Water (Kjemisk felling og sedimentering av wallboardvann),
W78-00984 5D

ROGERS, R. D.
Methylation of Mercury in a Terrestrial Environment,
W78-00926 5B

ROHDE, J. E.
Analysis of a Solar Collector Field Water Flow Network,
W78-01032 8B

ROMANENKO, V. I.
Microbiological Processes in the Meromictic Lake Valle de San Juan in Cuba (In Russian),
W78-01180 2H

RONNING, O.
Chemical Precipitation and Sedimentation of Wallboard Mill Waste Water (Kjemisk felling og sedimentering av wallboardvann),
W78-00984 5D

ROZMARIN, G.
Study of Factors Influencing the Physico-Chemical Purification of Pulp and Paper Industry Waste Waters With Aluminum Sulfate (Studiul factorilor care influenteaza epurarea fizico- chimica a apelor reziduale din industria celulozei si hirtiei),
W78-00983 5D

RUSSEL, W. B.
Soil Survey Interpretations for Earth Dams,
W78-00938 8D

SANDMANN, H.
Modern Methods of Effluent Treatment,
W78-01177 5D

SANSEBASTIANO, G.
Research on the Water Quality of the River Taro from Formova to the Mouth (In Italian),
W78-01016 5B

SCAIEF, J. F.
State of the Art: Wastewater Management in the Beverage Industry,
W78-01168 5D

SCALF, M. R.
Environmental Effects of Septic Tank Systems,
W78-00967 5B

SCHELSKIE, C. L.
Distribution of Water Masses in and Near the Straits of Mackinac,
W78-01038 2H

SCHOONBEE, H. J.
The Use of the Isotope 32P in the Study of Some Ecological Aspects of a Laboratory Stream Ecosystem (In Afrikaans),
W78-00945 5A

SCOTNEY, D. M.
Soil Survey Interpretations for Earth Dams,
W78-00938 8D

AUTHOR INDEX

SCOTT, M.

SCOTT, M.
Limnological Data Report for the Maine Department of Environmental Protection -- U.S. Geological Survey Cooperative Lake Studies Project,
W78-01078 2H

SEBBAS, E.
Energy vs. Environment -- Friends or Foes,
W78-01103 5D

Waste Heat for Evaporation of Effluents,
W78-01105 5D

SEKIZAWA, Y.
Residue Analyses on 2-Amino-4-phenylthiazole, a Piscine Anesthetic, in Fishes -- III Metabolism in Rainbow Trout and Carp,
W78-00923 5A

SEREDA, G. A.
Spectrophotometric Determination of Mineral Oils in Water, (In Russian),
W78-00912 5A

SHAMASH, R.
Lime Treatment of Bleachery Effluent,
W78-01110 5D

SHAWE, F. J.
The Influence of Fertilizer-Applied Chlorine, Chlorine Content of Irrigation Water and Leaching of Chlorine on the Uptake of Chlorine By Tobacco (In Afrikaans),
W78-00943 3F

SHEINKERMAN, V. R.
Mechanical Dewatering of Sediments from Roofing Board Factory Effluents (Optymekhanicheskogo obezvozhivaniya osadkov stochnykh vod kartonno-ruberoindnykh zavodov),
W78-01120 5E

SHELTON, M. L.
The 1976 and 1977 Drought in California: Extent and Severity,
W78-01134 2B

SHEPHERD, W.
Indices of Plant Water Status: Some Comparisons Within and Between Crop Species,
W78-01050 2I

SHIMURA, M.
Residue Analyses on 2-Amino-4-phenylthiazole, a Piscine Anesthetic, in Fishes -- III Metabolism in Rainbow Trout and Carp,
W78-00923 5A

SHUMAS, F. J.
Outfall Diffuser Systems -- Design and Installation,
W78-01126 8B

SIDIK, S. M.
Meteorological Adjustment of Yearly Mean Values for Air Pollutant Concentration Comparisons,
W78-01153 2B

SIMMONS, M. S.
Distribution of Water Masses in and Near the Straits of Mackinac,
W78-01038 2H

SINTON, J. M.
Maryland Highway Drainage Study: Volume VIII - A Physical Simulation Model of Runoff into Highway Cracks,
W78-01064 8B

SISCO, H. G.
Ground-Water Levels and Descriptions of Observation Wells in Idaho, 1975,
W78-01089 2F

SLACK, L. J.
Nitrogen Loads and Concentrations in Florida Streams,
W78-01082 7C

SMEDMAN, L.
Process Concepts for Oxygen Delignification,
W78-01106 5D

SMITH, E. D.
Development of an Unconventional Approach to Nitrification-Denitrification,
W78-01002 5D

SMITH, J. K.
Dialysis for Concentration and Removal of Industrial Wastes,
W78-01162 5D

SMITH, L. L. JR.
Effect of Chronic Exposure of Brook Trout to Sublethal Concentrations of Hydrogen Cyanide,
W78-00915 5C

SMITH, L. L. JR.
Effect of Hydrogen Sulfide on Fish and Invertebrates Part II-Hydrogen Sulfide Determination and Relationship Between pH and Sulfide Toxicity,
W78-00925 5C

SNYMAN, H. G.
The Influence of Fertilizer-Applied Chlorine, Chlorine Content of Irrigation Water and Leaching of Chlorine on the Uptake of Chlorine By Tobacco (In Afrikaans),
W78-00943 3F

SOLOMAN, R. C.
Environmental Inventory and Assessment of Navigation Pools 24, 25, and 26, Upper Mississippi and Lower Illinois Rivers; Summary Report,
W78-01028 6G

SOUSA, R. J.
The Influence of Ammonia on the Oxygen Delivery System of Coho Salmon Hemoglobin,
W78-00916 5C

SPAULDING, M.
Numerical Modeling of Pollutant Transport Using a Lagrangian Marker Particle Technique,
W78-01069 5G

SPAVEN, J. W.
The International Crops Research Institute for the Semi-Arid Tropics,
W78-01051 10D

STALLION, M.
1974 Ice Breakup on the Chena River,
W78-01013 2C

STANCIU, C.
Considerations and Possibilities of Optimizing the Water Circuits of the Braila Pulp and Paper Mill (Consideratii si posibilitati privind optimizarea circuitelor apelor de fabricatie la C.C.H.-Braila),
W78-00985 3E

STERNBURG, Y. M.
Maryland Highway Drainage Study: Volume VIII - A Physical Simulation Model of Runoff into Highway Cracks,
W78-01064 8B

STEWART, C. R.
Effect of Water Stress on Proline Synthesis from Radioactive Precursors,
W78-01042 2I

STEYN, D. J.
Nitrogen Yield Coefficient of the Green Alga, *Selenastrum Capricornutum* Printz,
W78-01000 5C

STOCKMAN, G. B.
Leather Tannery Waste Management Through Process Change, Reuse and Treatment,
W78-01156 5D

SUKHOVA, L. A.
Mechanical Dewatering of Sediments from Roofing Board Factory Effluents (Optymekhanicheskogo obezvozhivaniya osadkov stochnykh vod kartonno-ruberoindnykh zavodov),
W78-01120 5E

SUNADA, D. K.
Mathematical Modeling of Natural Groundwater Recharge,
W78-00974 2F

SUZUKI, A.
Residue Analyses on 2-Amino-4-phenylthiazole, a Piscine Anesthetic, in Fishes -- III Metabolism in Rainbow Trout and Carp,
W78-00923 5A

SWANEPoEL, J. H.
The Use of the Isotope 32P in the Study of Some Ecological Aspects of a Laboratory Stream Ecosystem (In Afrikaans),
W78-00945 5A

SWART, J. S.
Quantitative Map Interpretation in Regional Planning Surveys (In Afrikaans),
W78-00934 7C

SWEAZY, R. M.
Development of an Unconventional Approach to Nitrification-Denitrification,
W78-01002 5D

SYGO, J. J.
Short-Term Transient Variations of Limnological Parameters in Grand Traverse Bay, Lake Michigan,
W78-01033 2H

SYVERTSEN, J. P.
Rate of Leaf Production and Senescence and Effect of Leaf Age on Net Gas Exchange in Creosotebush,
W78-01054 2I

TALIS, F.
Experiments on the Optimization of Solids Recovery from Excess Recirculated Paper Mill White Water in Sveen-Pedersen Savealls (Incerari de optimizare a procesului de recuperare a materialului din apele re circulante excedentare de la fabricarea hirtiei, la recuperatorul Sveen-Pedersen),
W78-00982 5D

TASE, N.
Area-Deficit-Intensity Characteristics of Droughts,
W78-01025 2B

TAYFUN, M. A.
Analysis of Inhomogeneous Wave Number Spectra,
W78-00978 2L

AUTHOR INDEX

WELCH, H. E.

THOMPSON, G. D.
Irrigation of Sugar Cane,
W78-00928 3F

THOMSON, S. V.
Mechanisms of Survival of Zoospores of
Phytophthora Parasitica in Irrigation Water,
W78-01055 3F

THORNE, C. R.
Direct Measurements of Secondary Currents in
River Bends,
W78-01067 2E

THURLOW, D. L.
Effects of Burrowing Tubificid Worms on the
Exchange of Phosphorus Between Lake Sediment
and Overlying Water,
W78-00921 5C

TOERIEN, D. F.
Algal Bioassays and Nitrogen Fixation,
W78-00940 5A

Nitrogen Yield Coefficient of the Green Alga,
Selenastrum Capricornutum Printz,
W78-01000 5C

TOTOLIN, M.
Study of Factors Influencing the Physico-Chemical Purification of Pulp and Paper Industry
Waste Waters With Aluminum Sulfate
(Studiul factorilor care influenteaza epurarea
fizico- chimica a apelor reziduale din industria
celulozei si hirtiei),
W78-00983 5D

TOWLER, W.
Hiker Perception of Wilderness: A Study of the
Social Carrying Capacity of the Grand Canyon,
W78-01047 6B

TRAHAN, C. C.
Three-Dimensional Seepage Model Study
Oakley Dam, Sangamon River, Illinois,
W78-01068 8B

TRIPATHI, N.
Influence of Certain Factors on Rainfall
Frequency Values,
W78-01144 2B

TRNKA, W. C.
Innovative Rinse-and-Recovery System for
Metal Finishing Processes,
W78-01165 5D

TUNNICLIFFE, V.
Relationships Between the Bivalve Macoma
Balthica and Bacteria in Intertidal Sediments:
Minas Basin, Bay of Fundy,
W78-00905 5C

TUNSTALL, E. B.
Vortex Generation by Oscillatory Flow Over
Rippled Surfaces,
W78-00979 2L

UKISHIMA, Y.
Follow-Up Investigation on Cyanide Complex
Detected from Pulp Sludge (Seisi suragi kara
kenshutsu sareta shian kagobutsu ni tsuite no
tsuiseki chosa),
W78-01174 5B

ULABY, F. T.
Microwave Remote Sensing of Soil Water Content,
W78-01056 2G

UNNO, C.
Follow-Up Investigation on Cyanide Complex
Detected from Pulp Sludge (Seisi suragi kara
kenshutsu sareta shian kagobutsu ni tsuite no
tsuiseki chosa),
W78-01174 5B

URZENDOWSKI, R.
The Activity of Trace Metals in Aqueous
Systems and the Effect of Corrosion Control
Inhibitors,
W78-01057 8G

VACHAUD, G.
Solute Transfer, with Exchange Between Mobile
and Stagnant Water, Through Unsaturated
Sand,
W78-01065 2G

VAN AS, D.
Trace Element Concentrations in Marine Organisms
from the Cape West Coast,
W78-00937 5B

VAN DEN BERG, J. A.
The Effect of Seasonal Grazing on the Infiltration
Capacity of Soils in a Cymbopogon-Themedra Veld (In Afrikaans),
W78-00949 2G

VAN EEDEN, J. A.
Aspects of the Freshwater Mollusca of the
Pongola River Flood Plain Pans,
W78-01008 2E

VAN GRAAN, J. J. M.
The Use of the Isotope 32P in the Study of
Some Ecological Aspects of a Laboratory
Stream Ecosystem (In Afrikaans),
W78-00945 5A

VASTANO, A. C.
An Analysis of Drag Coefficient at Hurricane
Windspeeds from a Numerical Simulation of
Dynamical Water Level Changes in Lake
Okeechobee, Florida,
W78-01023 2H

VENUGOPAL, G.
A High-Resolution Electronic Rainfall Intensity
Recorder and Totaliser,
W78-01142 2B

VERWEY, J. F.
The Role of Water Nutrition and Yield Level in
the Grain-Stalk Ratio of Maize (In Afrikaans),
W78-00946 3F

VETTERNANTA, I.
Enso-Biox Method -- A Biological Method for
Purifying Kraft Pulp Mill Condensates,
W78-01100 5D

VILJOEN, L.
Uses of Phragmites Australis (In Afrikaans),
W78-00933 4A

VISSEER, P. S.
The Effect of Large Dams on River Water
Temperature Below the Dams, with Special
Reference to Bilharzia and the Verwoerd Dam,
W78-00997 6G

VLEGGAAR, C. M.
Trace Element Concentrations in Marine Organisms
from the Cape West Coast,
W78-00937 5B

VOGEL, A. H.
Short-Term Transient Variations of Limnological
Parameters in Grand Traverse Bay, Lake
Michigan,
W78-01033 2H

VOGT, C.
The Role of Toxic Compounds in the Revision
of the 1983 Effluent Guidelines,
W78-01122 6E

VORSTER, L. F.
The Effect of Seasonal Grazing on the Infiltration
Capacity of Soils in a Cymbopogon-Themedra Veld (In Afrikaans),
W78-00949 2G

VYKHRISTYUK, L. A.
Distribution of Organic Matter in Lake Baikal
Sediments (Ob osobennostyah raspredeleniya
organicheskogo veshchestva v osadkakh
Baikal),
W78-00981 2H

VYMAZAL, P.
Chemical Agents Used in the Effluent Treatment
Plant (Pomocte chemickie prostredky v
cistirne odpadnicich vod),
W78-00987 5D

WAGNER, D. M.
Water Quality Studies of Sixteen Minnesota
Rivers Tributary to Lake Superior,
W78-01036 5A

WALDEN, C. C.
Analysis and Characterization of Suspended
Solids in Pulp and Paper Mill Effluent,
W78-01102 5A

Detoxification of Bleached Kraft Mill Effluents
-- A Manageable Problem,
W78-01127 5D

WALKER, J.
Microbial Self-Purification by the Lagoon
Method, (In French),
W78-00910 5D

WALMSLEY, R. D.
Algal Bioassays and Nitrogen Fixation,
W78-00940 5A

WANG, H.
Analysis of Inhomogeneous Wave Number
Spectra,
W78-00978 2L

Mechanics of Suspended Sediment in Random
Waves,
W78-00980 2L

WARNQVIST, B.
Closing up Kraft Mill Systems -- Reduction of
Effluents and Control of Material Balances,
W78-01108 3E

WEAVER, R. E. C.
Dialysis for Concentration and Removal of Industrial
Wastes,
W78-01162 5D

WEBER, B. L.
Ocean Surface Currents Mapped by Radar,
W78-01133 2L

WEBER, H. A.
Waste-Water Treatment: Ecological,
Technological and Economic Aspects (In German),
W78-01163 5D

WELCH, H. E.
Phytoplankton, Phytoplankton Growth and
Biomass Cycles in an Unpolluted and in a Polluted
Polar Lake,
W78-00920 5C

AUTHOR INDEX

WENDORF, F.

WENDORF, F.
Late Pleistocene and Recent Climatic Changes
in the Egyptian Sahara,
W78-01043 2A

WESTERBERG, E. N.
Energy vs. Environment -- Friends or Foes,
W78-01103 5D

Waste Heat for Evaporation of Effluents,
W78-01105 5D

WESTERDAHL, H. E.
Application of Ecosystem Modeling
Methodologies to Dredged Material Research,
W78-01070 5A

WHITAKER, R. E.
An Analysis of Drag Coefficient at Hurricane
Windspeeds from a Numerical Simulation of
Dynamical Water Level Changes in Lake
Okeechobee, Florida,
W78-01023 2H

WHITE, G.
Spectrofluorometric Differentiation of the Red
Tide Alga, *Gonyaulax Tamarensis* from Other
Algae Common to New England Waters,
W78-00950 5C

WHITE, R. L.
Dissolved Air Flotation for Combined Sewer
Overflows,
W78-00995 5D

WICKHAM, D. E.
Egg Mortalities in Wild Populations of the Dungeness
Crab in Central and Northern California,
W78-00902 5C

WIERENGA, P. J.
Solute Transfer, with Exchange Between Mobile
and Stagnant Water, Through Unsaturated
Sand,
W78-01065 2G

WILLIAMSON, A. R.
Naval Stores Wastewater Purification and
Reuse by Activated Carbon Treatment,
W78-01160 5D

WILLIAMSON, D.
Observation of Bilinear Systems with Application
to Biological Control,
W78-01183 5A

WILSON, D. J.
Foam Flotation Treatment of Heavy Metals
and Fluoride-Bearing Industrial Wastewaters,
W78-01164 5D

WISE, H. F.
Policy Implications of Urban Land Practices
for Groundwater Quality,
W78-00958 4C

WON, K. W.
Extraction of Chemical Pollutants from Industrial
Wastewaters with Volatile Solvents,
W78-01171 5D

WONG, A.
Toxicity, BOD, and Colour of Effluents from
the Kraft Pulping of Bole Wood Containing
High Quantities of Bark,
W78-01128 5B

Treatment of Pulp and Paper Mill Effluents
Using Physical-Chemical Techniques,
W78-01111 5D

WORTHINGTON, P. F.
Hydrogeological Aspects of the Richards Bay
Area, South Africa,
W78-00998 2F

WRIGHT, D. A.
Environmental Inventory and Assessment of
Navigation Pools 24, 25, and 26, Upper Mississippi
and Lower Illinois Rivers; Summary Report,
W78-01028 6G

WYRTKI, K.
Advection in the Peru Current as Observed by
Satellite,
W78-01073 7B

YANG, C. Y.
Analysis of Inhomogeneous Wave Number
Spectra,
W78-00978 2L

YANG, H. Y.
Utilization of Cheese Whey for Wine Production,
W78-01170 5E

ZARIC, L.
Study of the Influence of Soil Drought and
High Air Temperature on Some Physiological
Processes in Maize Plant (In Serbo-Croatian),
W78-01018 2I

ZARRIN, M. P.
Rainwater and Sediment Runoff from Slopes in
the Azov-Kuban Plain,
W78-01046 2J

ZBORISHCHUK, N. G.
Air Regime of Nonirrigated and Irrigated
Caucasian Chernozems,
W78-01049 3F

ZIELINSKI, J.
Effect of Various Technological Factors on the
Color of Pulp Mill Effluents (Wpływ różnych
czynników technologicznych na barwę ścieków
pocelulozowych),
W78-00989 5B

ORGANIZATIONAL INDEX

ABCOR, INC., WILMINGTON, MA. Reverse Osmosis Field Test: Treatment of Watts Nickel Rinse Waters, W78-01161	5D	ARIZONA STATE UNIV., TEMPE. BUREAU OF BUSINESS AND ECONOMIC RESEARCH. The Impact of Second-Home Development on Water Availability in North Central Arizona, W78-01052	4C	Detoxification of Bleached Kraft Mill Effluents - A Manageable Problem, W78-01127	5D
ACADEMY OF MUNICIPAL ECONOMY, MOSCOW (USSR). RESEARCH OF PUBLIC WATER SUPPLY, WATER PURIFICATION. Mechanical Dewatering of Sediments from Roofing Board Factory Effluents (Opty mek- hanicheskogo obezvozhivaniya osadkov stochnykh vod kartonno-ruberoidnykh zavodov), W78-01120	5E	ARIZONA UNIV., TUCSON. DIV. OF ECONOMIC AND BUSINESS RESEARCH. Hiker Perception of Wilderness: A Study of the Social Carrying Capacity of the Grand Canyon, W78-01047	6B	BATTELLE COLUMBUS LAB., OH. Ammonium-Carbonate Leaching of Metal Values from Water-Treatment Sludges, W78-01166	5D
AGRICULTURAL RESEARCH INST., MIDDLEBURG (SOUTH AFRICA). Uses of Phragmites Australis (In Afrikaans), W78-00933	4A	ARMY ENGINEER DISTRICT, VICKSBURG, MS. COMMITTEE ON TIDAL HYDRAULICS. Umpqua River Entrance, Oregon. W78-01152	8B	BILHARZIA FIELD RESEARCH UNIT, NELSPRUIT (SOUTH AFRICA). The Effect of Large Dams on River Water Temperature Below the Dams, with Special Reference to Bilharzia and the Verwoerd Dam, W78-00997	6G
AGRICULTURAL RESEARCH SERVICE, STILLWATER, OK. WATER CONSERVATION STRUCTURES LAB. Friction Factors for Vegetated Waterways of Small Slope, W78-01031	2E	ARMY ENGINEER DIV. NORTH PACIFIC, BONNEVILLE, OR. DIV. HYDRAULIC LAB. Filling and Emptying System, Little Goose Lock, Snake River, Washington, Hydraulic Model Investigation, W78-01061	8A	BOTANICAL RESEARCH UNIT, DURBAN (SOUTH AFRICA). Some Observed Interrelationships Between the Cover of Aquatic Vegetation and Various Physical Properties of the Water Medium, W78-00941	2I
AGRICULTURAL RESEARCH STATION, BETHLEHEM (SOUTH AFRICA). Quantitative Map Interpretation in Regional Planning Surveys (In Afrikaans), W78-00934	7C	ARMY ENGINEER WATERWAYS EXPERIMENT STATION, VICKSBURG, MISS. ENVIRONMENTAL EFFECTS LAB. Environmental Inventory and Assessment of Navigation Pools 24, 25, and 26, Upper Missis- sippi and Lower Illinois Rivers; Summary Re- port, W78-01028	6G	BRITISH COLUMBIA RESEARCH COUNCIL, VANCOUVER. Flocculating Agents Derived from Kraft Lig- nin, W78-00988	5D
AKADEMIYA NAUK SSSR, LENINGRAD. INST. OZEROVEDENIYA. Rainwater and Sediment Runoff from Slopes in the Azov-Kuban Plain, W78-01046	2J	ARMY ENGINEER WATERWAYS EXPERIMENT STATION, VICKSBURG, MISS. HYDRAULICS LAB. Waianae Small-Boat Harbor, Oahu, Hawaii, Design for Wave Protection, Hydraulic Model Investigation, W78-01026	8A	CALIFORNIA STATE UNIV., FRESNO. DEPT. OF GEOGRAPHY. Pacific Sea-Surface Temperature Related to Rain in California, W78-01066	2B
AKADEMIYA NAUK SSSR, MOSCOW. INST. GEOGRAFIL. Calcium Carbonates in Suspended Deposits of Rivers and Irrigation Systems in Central Asia (In Russian), W78-01072	2J	ARMY ENGINEER WATERWAYS EXPERIMENT STATION, VICKSBURG, MS. Three-Dimensional Seepage Model Study Oakley Dam, Sangamon River, Illinois, W78-01068	8B	CALIFORNIA UNIV., BERKELEY. DEPT. OF CHEMICAL ENGINEERING. Extraction of Chemical Pollutants from Indus- trial Wastewaters with Volatile Solvents, W78-01171	5D
ALBUQUERQUE UNIV., NM. The Activity of Trace Metals in Aqueous Systems and the Effect of Corrosion Control Inhibitors, W78-01057	8G	ARMY ENGINEER WATERWAYS EXPERIMENT STATION, VICKSBURG, MS. ENVIRONMENTAL EFFECTS, LAB. Application of Ecosystem Modeling Methodologies to Dredged Material Research, W78-01070	5A	CALIFORNIA UNIV., BERKELEY. DEPT. OF PLANT PATHOLOGY. Mechanisms of Survival of Zoospores of Phytophthora Parasitica in Irrigation Water, W78-01055	3F
ALLEGHENY LUDLUM INDUSTRIES, INC., PITTSBURGH, PA. Downhole Drilling Motor Creates High Torque at Low Speeds, W78-00964	8C	ARMY TERRESTRIAL SCIENCES CENTER, HANOVER, NH. APPLIED RESEARCH BRANCH. Ice Force Measurements on the Pembina River, Alberta, Canada, W78-01154	2C	CALIFORNIA UNIV., BODEGA BAY. BODEGA MARINE LAB. Egg Mortalities in Wild Populations of the Dun- geness Crab in Central and Northern Califor- nia, W78-00902	5C
ALRON INDUSTRIES, INC., ROCHESTER, NY. Ozone: The Water Conditioning Process of the Future Today, W78-00953	5F	ATOMIC ENERGY BOARD, PRETORIA (SOUTH AFRICA). Trace Element Concentrations in Marine Or- ganisms from the Cape West Coast, W78-00937	5B	CALIFORNIA UNIV., DAVIS. DEPT. OF GEOGRAPHY. The 1976 and 1977 Drought in California: Ex- tent and Severity, W78-01134	2B
AMERICAN INST. OF PLANNERS, WASHINGTON, DC. Policy Implications of Urban Land Practices for Groundwater Quality, W78-00958	4C	AUSSEDAT-REY PAPETERIES DE FRANCE, SAILLAT. Adjustments and Innovation in a French Paper Mill (Adjustements et innovations dans une papeterie française), W78-01101	5D	CAMP, DRESSER AND MCKEE, BELMONT, CA. WATER RESOURCES DIV. National Water Commission Views Ground- water Protection, W78-00966	4B
ARGONNE NATIONAL LAB., IL. Results from a Numerical Model for Simulating Circulation Patterns and Chlorinity Distribu- tions in Saginaw Bay, W78-01040	2H	B. C. RESEARCH LTD., VANCOUVER. Analysis and Characterization of Suspended Solids in Pulp and Paper Mill Effluent, W78-01102	5A	CAMP, DRESSER AND MCKEE, INC., BOSTON, MA. Physical-Chemical Treatment System at Fitchburg, Massachusetts, W78-01125	5D
Free Mode Coupling of Saginaw Bay and Lake Huron, W78-01041	2H	CAPE TOWN UNIV. (SOUTH AFRICA). DEPT. OF ZOOLOGY. Distribution of Benthic Macrofauna in Lan- gebaan Lagoon, W78-00999	2L		
Comparison of Model and Observed Currents in Lake Michigan, W78-01140	2H				

ORGANIZATIONAL INDEX

CEA CENTRE D'ETUDES NUCLEAIRES DE SACLAY, GIF SUR YVETTE (FRANCE).

CEA CENTRE D'ETUDES NUCLEAIRES DE SACLAY, GIF SUR YVETTE (FRANCE).

Study of Mass Transfer at the Air-Water Interface by an Isotopic Method,

W78-00977 2D

CEDARA AGRICULTURAL COLL., PIETERMARITZBURG (SOUTH AFRICA).

RESEARCH INST.

Soil Survey Interpretations for Earth Dams,

W78-00938 8D

CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE, PARIS (FRANCE).

Solute Transfer, with Exchange Between Mobile and Stagnant Water, Through Unsaturated Sand,

W78-01065 2G

CENTRE UNIV. DE LUMINY, MARSEILLE (FRANCE).

Dissolved Oxygen and Saturation in an Environment of High Organic Production (Etang De Berre); Role of Halocline on Distribution of These and on the Oxygen-Phosphate Ratio (In French),

W78-00935 2L

CIP RESEARCH LTD., HAWKESBURY (ONTARIO).

Lime Treatment of Bleachery Effluent,

W78-01110 5D

CLINTON BOGERT ASSOCIATES, FORT LEE, NJ.

Sampling of Industrial Wastewater Helps Meet Discharge Standards,

W78-01073 7B

COASTAL ENGINEERING RESEARCH CENTER, FORT BELVOIR, VA.

Stability of Gobi Block Revetment to Wave Attack,

W78-01027 8F

COLD REGIONS RESEARCH AND ENGINEERING LAB., FAIRBANKS, ALASKA.

ALASKAN PROJECTS OFFICE.

1974 Ice Breakup on the Chena River,

W78-01013 2C

COLORADO STATE UNIV., FORT COLLINS.

Reservoir Capacity for Periodic-Stochastic Input and Periodic Output,

W78-01012 4A

Area-Deficit-Intensity Characteristics of Droughts,

W78-01025 2B

COLORADO STATE UNIV., FORT COLLINS.

ENGINEERING RESEARCH CENTER.

Direct Measurements of Secondary Currents in River Bends,

W78-01067 2E

COLORADO UNIV., BOULDER. INST. OF ARCTIC AND ALPINE RESEARCH.

Avalanche Release and Snow Characteristics, San Juan Mountains, Colorado.

W78-01062 2C

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION, ASPENDALE (AUSTRALIA). DIV. OF ATMOSPHERIC PHYSICS.

Indices of Plant Water Status: Some Comparisons Within and Between Crop Species,

W78-01050 2I

CORNELL UNIV., ITHACA, NY.

Fatal Disease,

W78-01021 5C

DAIRY RESEARCH AND DEVELOPMENT CORP., PEEKSKILL, NY.

Elimination of Pollution from Cottage Cheese Whey by Drying and Utilization,

W78-01167 5D

DELAWARE UNIV., NEWARK.

Analysis of Inhomogeneous Wave Number Spectra,

W78-00978 2L

DELAWARE UNIV., NEWARK. DEPT. OF CIVIL ENGINEERING; AND DELAWARE UNIV., NEWARK. COLL. OF MARINE STUDIES.

A Mechanism for Rip Current Generation on an Open Coast,

W78-00976 2L

Mechanics of Suspended Sediment in Random Waves,

W78-00980 2L

DEPARTMENT OF NATIONAL PARKS AND WILDLIFE MANAGEMENT, NORTON (RHODESIA).

Juvenile Fish Populations in the Marginal Areas of Lake McIlwaine, Rhodesia,

W78-01007 2H

DEPARTMENT OF THE ENVIRONMENT, BURLINGTON (ONTARIO). INLAND WATERS BRANCH.

Sediment Distribution and Bottom Topography of Southeastern Lake Superior,

W78-01034 2J

ECODYNE CORP., ST. PAUL, MN. LINDSAY DIV.

Continuous Chlorination of Contaminated Water,

W78-00971 5D

ECOSYSTEMS INTERNATIONAL, INC., GAMBRILLS, MD.

User Requirements and User Acceptance of Current and Next-Generation Satellite Mission and Sensor Complement, Oriented Toward the Monitoring of Water Resources,

W78-01155 7B

EKONO, HELSINKI (FINLAND).

Energy vs. Environment -- Friends or Foes,

W78-01103 5D

Waste Heat for Evaporation of Effluents,

W78-01105 5D

ENGINEERING-SCIENCE, INC., ARCADIA, CA.

Dissolved Air Flotation for Combined Sewer Overflows,

W78-00995 5D

ENSO-GUTZEIT OY, IMATRA (FINLAND).

Enso-Biox Method -- A Biological Method for Purifying Kraft Pulp Mill Condensates,

W78-01100 5D

ENTOMOL. A.V.D., UPPSALA, SWED.

Ecological Aspects of Cooling Water Discharges. (In Swedish),

W78-00922 5C

ENVIRONMENTAL MONITORING AND SUPPORT LAB., LAS VEGAS, NV.

Methylation of Mercury in a Terrestrial Environment,

W78-00926 5B

ENVIRONMENTAL PROTECTION AGENCY, WASHINGTON, DC.

The Role of Toxic Compounds in the Revision of the 1983 Effluent Guidelines,

W78-01122 6E

ENVIRONMENTAL PROTECTION AGENCY, WASHINGTON, DC. OFFICE OF AIR AND WATER PROGRAMS.

Methods for Identifying and Evaluating the Nature and Extent of Non-point Sources of Pollutants.

W78-01024 5B

ENVIRONMENTAL RESEARCH LAB., GULF BREEZE, FL.

A Saltwater Flow-Through Bioassay Method with Controlled Temperature and Salinity,

W78-00917 5A

ESCHER WYSS G.M.B.H. RAVENSBURG (WEST GERMANY).

Disposal and Recycling of Rejects from Waste Paper and Closed Water Systems,

W78-01114 3E

EXETER UNIV. (ENGLAND).

Fitting the Pearson Type 3 Distribution in Practice,

W78-01136 2E

FISHERIES AND MARINE SERVICE, ST.

ANDREWS (NEW BRUNSWICK). BIOLOGICAL STATION.

Fenitrothion Toxicity to the Freshwater Crayfish, *Oncorhynchus limosus*,

W78-00904 5C

FLORIDA INST. OF TECH., MELBOURNE DEPT. OF BIOLOGICAL SCIENCES.

Toxicities of 'Excessively' Chlorinated Organic Compounds,

W78-00901 5C

GAUHATI UNIV. (INDIA). DEPT. OF STATISTICS.

A Markov Chain Model for the Occurrences of Dry and Wet Days,

W78-01143 2B

GEOLOGICAL SURVEY, AUGUSTA, ME.

WATER RESOURCES DIV.; AND MAINE DEPT. OF ENVIRONMENTAL PROTECTION, AUGUSTA. DIV. OF LAKES AND BIOLOGICAL STUDIES.

Limnological Data Report for the Maine Department of Environmental Protection -- U.S. Geological Survey Cooperative Lake Studies Project,

W78-01078 2H

GEOLOGICAL SURVEY, BOISE, ID. WATER RESOURCES DIV.

Ground-Water Levels and Descriptions of Observation Wells in Idaho, 1975,

W78-01089 2F

GEOLOGICAL SURVEY, JACKSONVILLE, FL. WATER RESOURCES DIV.

Thickness of the Potable-Water Zone in the Floridan Aquifer,

W78-01081 2F

GEOLOGICAL SURVEY, LAKWOOD, CO. WATER RESOURCES DIV.

Reconnaissance of Ground-Water Resources in a Part of the Yampa River Basin Between Craig and Steamboat Springs, Moffat and Routt Counties, Colorado,

W78-01086 2F

ORGANIZATIONAL INDEX
INSTITUT FRANCAISE DU PETROLES (GRENOBLE). DIV. DES TECHNIQUES DE FORAGE

GEOLOGICAL SURVEY, NASHVILLE, TN.	
WATER RESOURCES DIV.	
Water Resources Data for Tennessee, Water Year 1975.	
W78-01091	7C
GEOLOGICAL SURVEY OF CANADA, OTTAWA (ONTARIO).	
Observed Mixing Lengths in Mountain Streams,	
W78-01150	2E
GEOLOGICAL SURVEY, OKLAHOMA CITY, OK. WATER RESOURCES DIV.	
A Preliminary Appraisal of the Garber-Wellington Aquifer, Southern Logan and Northern Oklahoma Counties, Oklahoma,	
W78-01075	7C
Hydrologic Data for the Vamoosa Aquifer, East-Central Oklahoma,	
W78-01076	2A
Analysis of Street Sweepings, Portland, Oregon,	
W78-01077	5A
GEOLOGICAL SURVEY, PORTLAND, OR.	
WATER RESOURCES DIV.	
Lakes of Oregon: Volume 5. Marion County,	
W78-01080	2H
Water Resources Data for Oregon, Water Year 1976.	
W78-01092	7C
GEOLOGICAL SURVEY, RESTON, VA.	
GEOLOGY DIV.	
The United States Geological Survey in Alaska: Accomplishments During 1976.	
W78-01096	7C
GEOLOGICAL SURVEY, RESTON, VA.	
WATER RESOURCES DIV.	
Comparative Assessment of Water Use and Environmental Implications of Coal Slurry Pipelines,	
W78-01085	8A
Summary of Geologic and Hydrologic Information Pertinent to Tunneling in Selected Urban Areas,	
W78-01090	8B
Water Consumption by Nuclear Powerplants and Some Hydrological Implications,	
W78-01097	7C
GEOLOGICAL SURVEY, ROLLA, MO. WATER RESOURCES DIV.	
Water Resources Data for Missouri, Water Year 1976.	
W78-01083	7C
GEOLOGICAL SURVEY, SACRAMENTO, CA.	
WATER RESOURCES DIV.; AND	
GEOLOGICAL SURVEY, PORTLAND, OR.	
WATER RESOURCES DIV.	
Ground-Water Resources of the Lower Santiam River Basin, Middle Willamette Valley, Oregon,	
W78-01084	4B
GEOLOGICAL SURVEY, TACOMA, WA.	
WATER RESOURCES DIV.; AND STANFORD RESEARCH INSTITUTE, MENLO PARK, CA.	
Comparison of Different Methods for Estimating Snowcover in Forested, Mountainous Basins Using LANDSAT (ERTS) Images,	
W78-01093	7B
GEOLOGICAL SURVEY, TALLAHASSEE, FL.	
WATER RESOURCES DIV.	
Nitrogen Loads and Concentrations in Florida Streams,	
W78-01082	7C
Public Water Supplies of Selected Municipalities in Florida, 1975,	
W78-01098	6D
GEOLOGICAL SURVEY, TAMPA, FL. WATER RESOURCES DIV.	
A Hydrologic Description of Keystone Lake Near Tampa, Florida,	
W78-01088	2H
GEOLOGICAL SURVEY, TRENTON, NJ.	
WATER RESOURCES DIV.	
Summary of Ground-Water Conditions in the Jaffna Peninsula, Republic of Sri Lanka, With a Plan for Investigating Feasibility of Ground-Water Development,	
W78-01093	4B
GEOLOGICAL SURVEY, TUCSON, AZ.	
WATER RESOURCES DIV.	
Maps Showing Ground-Water Conditions in the Southern Part of the Chiricahua Area, Apache County, Arizona-1976,	
W78-01087	7C
GEOLOGICAL SURVEY, TUSCALOOSA, AL.	
WATER RESOURCES DIV.	
Water and Related Problems in Coal-Mine Areas of Alabama,	
W78-01094	5B
GERAGHTY AND MILLER, INC., PORT WASHINGTON, NY.	
How Recent Federal Legislation has Moved Toward Greater Protection of Groundwater Resources.	
W78-00969	6E
GLATFELTER CO., SPRING GROVE, PA.	
Start-up and Operating Experience with a Twin Wire Moving Belt Press for Primary Sludge,	
W78-01129	5D
GOODKIND AND O'DEA, INC., CLIFTON, NJ.	
Treatment System is Innovative for Coal Storage Facility,	
W78-01074	5D
GUELPH UNIV. (ONTARIO). SCHOOL OF ENGINEERING.	
Rainfall Intensity-Frequency Relationships from Monthly Extremes,	
W78-01149	2B
GULF SOUTH RESEARCH INST., NEW ORLEANS, LA.	
Dialysis for Concentration and Removal of Industrial Wastes,	
W78-01162	5D
HAWAII UNIV., HONOLULU. DEPT. OF OCEANOGRAPHY.	
Advection in the Peru Current as Observed by Satellite,	
W78-01137	7B
HEBREW UNIV., REHOVOTH (ISRAEL).	
FACULTY OF AGRICULTURE.	
Patella Vulgata: A Biological Monitor of Coastal Metal Pollution - A Preliminary Study,	
W78-00906	5A
HERCULES INC., HATTIESBURG, MS.	
Naval Stores Wastewater Purification and Reuse by Activated Carbon Treatment,	
W78-01160	5D
HERZBERGER PAPIERFABRIK LUDWIG OSTHUSSENREICH K.G., HERZBERG AM HARZ (WEST GERMANY).	
Utilization of Solids from Waste Water Treatment Plants in Board Manufacture,	
W78-01115	5D
HIROSHIMA UNIV. (JAPAN). DEPT. OF FISHERIES.	
Content and Uptake of Trace Metals in Benthic Algae, Enteromorpha and Porphyra II. Studies on the Algae Cultured in Sea Water Supplemented with Various Metals,	
W78-00924	5B
HIROSHIMA UNIV., (JAPAN). FACULTY OF FISHERIES AND ANIMAL HUSBANDRY.	
Content and Uptake of Trace Metals in Benthic Algae, Enteromorpha and Porphyra I. Measurement and Variation of Trace Metal Content of Porphyra Grown in Natural Environment,	
W78-00908	5B
HYDRONAUTICS, INC., LAUREL, MD.	
Cavitating Bit Jets Promise Faster Drilling for Deep-Hole Operations,	
W78-00957	8C
IDAHO STATE DEPT. OF HEALTH AND WELFARE, BOISE. COMMUNITY STUDY ON PESTICIDES.	
Swan Mortality Due to Certain Heavy Metals in the Mission Lake Area, Idaho,	
W78-00903	5C
IDAHO UNIV., MOSCOW. DEPT. OF AGRICULTURAL ENGINEERING.	
Least Cost Irrigation System Specifications for Various Conditions,	
W78-00973	3F
ILLINOIS UNIV. AT URBANA-CHAMPAIGN. DEPT. OF FORESTRY.	
Improved Procedures for Valuation of the Contribution of Recreation to National Economic Development,	
W78-01003	6B
INDIAN INST. OF SCIENCE, BANGALORE. DEPT. OF CIVIL ENGINEERING.	
Depressed Weir with Two Unequal Sheetpiles in Anisotropic Soil,	
W78-01151	2G
INDIAN INST. OF TECH., KHARAGPUR.	
Effects of Aquifer Thickness and Side Perforation on Discharge from Open Well,	
W78-00962	2F
INDUSTRIAL ENVIRONMENTAL RESEARCH LAB.-CINCINNATI, CORVALLIS, OR. FOOD AND WOOD PRODUCTS BRANCH.	
State of the Art: Wastewater Management in the Beverage Industry,	
W78-01168	5D
INDUSTRIAL FILTER AND PUMP MFG., CICERO, IL.	
Innovative Rinse-and-Recovery System for Metal Finishing Processes,	
W78-01165	5D
INSTITUT FRANCAISE DU PETROLES (GRENOBLE). DIV. DES TECHNIQUES DE FORAGE ET DE PRODUCTION.	
Unique Bit Design Improves Hydraulics and Performance,	
W78-00963	8C

ORGANIZATIONAL INDEX

INSTITUT GIGIENY TRUDA I PROFZABOLEVANII, SVERDLOVSK (USSR).

INSTITUT GIGIENY TRUDA I
PROFZABOLEVANII, SVERDLOVSK (USSR).
Spectrophotometric Determination of Mineral
Oils in Water, (In Russian),
W78-00912

5A

INSTITUT KUKURUZ, ZEMUN
(YUGOSLAVIA).

Study of the Influence of Soil Drought and
High Air Temperature on Some Physiological
Processes in Maize Plant (In Serbo-Croatian),
W78-01018

2I

INSTITUTE FOR WATER AND AIR
POLLUTION RESEARCH, STOCKHOLM
(SWEDEN).

Eutrophication of Lakes,
W78-01020

5C

INSTITUTE OF HYDROLOGY,
WALLIFORD(ENGLAND).

Simulation of the Inlet Hydrograph for Urban
Catchments,
W78-01147

2E

INSTITUTE OF HYDROLOGY,
WALLIFORD (ENGLAND).

A Study Into the Low-Flow Characteristics of
British Rivers,
W78-01148

2E

INSTYTUT CELULOZOWO-PAPIERNICZY,
WARSZAWA (POLAND).

Ascorbiometric Determination of Oxygen Content
in Water (Askorbinometryczna metoda oz-
naczania zawartości tlenu w wodzie),
W78-01119

5A

INTERNATIONAL CROPS RESEARCH INST.,
HYDERABAD (INDIA).

The International Crops Research Institute for
the Semi-Arid Tropics,
W78-01051

10D

INTERNATIONAL WATER SUPPLY LTD.,
MONTREAL (ONTARIO).

Installation, Operation and Maintenance of
Vertical Turbine Pumps,
W78-00961

8C

IOWA STATE UNIV. AMES. DEPT. OF
BOTANY AND PLANT PATHOLOGY.

Effect of Water Stress on Proline Synthesis
from Radioactive Precursors,
W78-01042

2I

ISTITUTO ITALIANO DI IDROBIOLOGIA,
PALLANZA.

Role of Un-ionized Ammonia in Predisposing
Gill Apparatus of *Alburnus alburnus* alborella
to Fungal and Bacterial Diseases,
W78-00918

5C

JORDAN (EDWARD C.), INC., PORTLAND,
ME.

Environmental Impact Assessments for U.S.
and Canadian Industries,
W78-01099

5C

KANSAS UNIV./CENTER FOR RESEARCH,
INC., LAWRENCE. REMOTE SENSING LAB.

Microwave Remote Sensing of Soil Water Content,
W78-01056

2G

KANSAS UNIV./CENTER FOR RESEARCH,
INC., LAWRENCE. SPACE TECHNOLOGY
CENTER.

Detection of Soil Moisture and Soil Characteristics
from Skylab,
W78-01058

7B

LILLE-1 UNIV., VILLENEUVE D'ASCQ
(FRANCE).

Microbial Self-Purification by the Lagoon
Method, (In French),
W78-00910

5D

LIMNOLOGICHESKII INST., IRKUTSK (USSR).

Distribution of Organic Matter in Lake Baikal
Sediments (Ob osobennostyakh raspredeleniya
organicheskogo veshchestva v osadkakh
Baikal),
W78-00981

2H

MACMILLAN BLOEDEL LTD., NANAIMO
(BRIGHT COLUMBIA).

Effluent Quality Improvement in a Bleached
Kraft Pulp Mill,
W78-01107

5D

MARYLAND UNIV., COLLEGE PARK. DEPT.
OF CIVIL ENGINEERING.

Maryland Highway Drainage Study: Volume
VIII - A Physical Simulation Model of Runoff
into Highway Cracks,
W78-01064

8B

MASSACHUSETTS INST. OF TECH.,
CAMBRIDGE.

Spectrofluorometric Differentiation of the Red
Tide Alga, *Gonyaulax tamarensis* from Other
Algae Common to New England Waters,
W78-00950

5C

MCMASTER UNIV., HAMILTON (ONTARIO).

DEPT. OF GEOLOGY.

Relationships Between the Bivalve *Macoma*
Balthica and Bacteria in Intertidal Sediments:
Minas Basin, Bay of Fundy,
W78-00905

5C

MELJI SEIKI KAISHA LTD., YOKOHAMA
(JAPAN). RESEARCH LABS.

Residue Analyses on 2-Amino-4-phenyl-
thiazole, a Fisine Anesthetic, in Fishes - III
Metabolism in Rainbow Trout and Carp,
W78-00923

5A

METEOROLOGICAL OFFICE, NEW DELHI
(INDIA).

Influence of Certain Factors on Rainfall
Frequency Values,
W78-01144

2B

METEOROLOGICAL OFFICE, POONA
(INDIA).

A High-Resolution Electronic Rainfall Intensity
Recorder and Totaliser,
W78-01142

2B

MICHIGAN UNIV., ANN ARBOR. GREAT
LAKES RESEARCH DIV.

Distribution of Water Masses in and Near the
Straits of Mackinac,
W78-01038

2H

MICHIGAN UNIV., ANN ARBOR. SEA GRANT
PROGRAM.

Short-Term Transient Variations of Limnological
Parameters in Grand Traverse Bay, Lake
Michigan,
W78-01033

2H

MINNESOTA UNIV., ST. PAUL. DEPT. OF

ENTOMOLOGY, FISHERIES AND WILDLIFE.
Effect of Chronic Exposure of Brook Trout to
Sublethal Concentrations of Hydrogen Cyanide,
W78-00915

5C

MINNESOTA UNIV., ST. PAUL, MN. DEPT. OF
ENTOMOLOGY, FISHERIES AND WILDLIFE.

Effect of Hydrogen Sulfide on Fish and Invertebrates Part II-Hydrogen Sulfide Determination and Relationship Between pH and Sulfide Toxicity,
W78-00925

5C

MISSOURI UNIV., ST. LOUIS. DEPT. OF
GEOLOGY.

The Interrelationships of the Longitudinal
Profiles and Channel Pattern for the Red River,
W78-01146

2E

MODOCELL A.B., ORNSKOLDSVIK
(SWEDEN).

New In-Plant Technology to Reduce Pollution
from a Sodium-Base Sulfite Mill,
W78-01104

5D

Process Concepts for Oxygen Delignification,
W78-01106

5D

MOSCOW STATE UNIV. (USSR). DEPT. OF
SOIL SCIENCE.

Air Regime of Nonirrigated and Irrigated
Caucasian Chernozems,
W78-01049

3F

NATAL UNIV., PIETERMARITZBURG (SOUTH
AFRICA). DEPT. OF BOTANY.

A Quantitative Sampler for Aquatic
Macrophytes,
W78-00929

7B

NATIONAL AERONAUTICS AND SPACE
ADMINISTRATION, CLEVELAND, OH. LEWIS
RESEARCH CENTER.

Analysis of a Solar Collector Field Water Flow
Network,
W78-01032

8B

Meteorological Adjustment of Yearly Mean
Values for Air Pollutant Concentration Comparisons,
W78-01153

2B

NATIONAL COUNCIL OF THE PAPER
INDUSTRY FOR AIR AND STREAM
IMPROVEMENT, INC., KALAMAZOO, MI.

Results of an NCASI Pilot Plant Study of
Mechanical Dewatering Alternatives for Waste
Activated Sludge,
W78-01123

5D

NATIONAL INST. FOR WATER RESEARCH,
PRETORIA (SOUTH AFRICA).

Algal Bioassays and Nitrogen Fixation,
W78-00940

5A

Nitrogen Yield Coefficient of the Green Alga,
Selenastrum capricornutum Printz,
W78-01000

5C

NATIONAL MARINE FISHERIES SERVICE,
SEATTLE, WA. NORTHWEST FISHERIES
CENTER.

Use of Salt (NaCl) Water to Reduce Mortality
of Chinook Salmon Smolts, *Oncorhynchus*
tshawytscha, During Handling and Hauling,
W78-00909

5G

NATIONAL OCEANIC AND ATMOSPHERIC
ADMINISTRATION, ANN ARBOR, MI. GREAT
LAKES ENVIRONMENTAL RESEARCH LAB.

Multiple Estimates of Lake Erie Evaporation,
W78-01035

2D

Detroit River Flow Characteristic and Their
Application to Chemical Loading Estimates,
W78-01037

2E

ORGANIZATIONAL INDEX

REGIONAL METEOROLOGICAL CENTRE, BOMBAY (INDIA).

IFYGL Shipboard Visual Wave Observations vs Wave Measurements, W78-01039	2H	NORWEGIAN PULP AND PAPER RESEARCH INST., OSLO. Chemical Precipitation and Sedimentation of Wallboard Mill Waste Water (Kjemisk felling og sedimentering av wallboardvann), W78-00984	5D	PENNSYLVANIA STATE UNIV., UNIVERSITY PARK. DEPT. OF CHEMICAL ENGINEERING. Pollutant Transfer into Water Bodies, W78-01019	5B
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, BOULDER, CO. ENVIRONMENTAL RESEARCH LABS. Ocean Surface Currents Mapped by Radar, W78-01133	2L	OAK RIDGE NATIONAL LAB., TN. Hydrologic and Chemical Budgets on Walker Branch Watershed-Observations and Modeling Applications, W78-01071	2A	PIISTER AND VOGEL TANNING CO., MILWAUKEE, WI. Leather Tannery Waste Management Through Process Change, Reuse and Treatment, W78-01156	5D
NATIONAL PHYSICAL RESEARCH LAB., PRETORIA (SOUTH AFRICA). Hydrogeological Aspects of the Richards Bay Area, South Africa, W78-00998	2F	OCCIDENTAL RESEARCH CORP., LA VERNE, CA. Pyrolysis of Industrial Wastes for Oil and Activated Carbon Recovery, W78-01172	5E	POLISH ACADEMY OF SCIENCES, WARSAW. DEPT. OF HYDROBIOLOGY. The River Skawa: Water Chemistry and Eutrophication, (In Polish), W78-00990	2K
NATIONAL WATER WELL ASSOCIATION, WORCESTER, MA. Well Redevelopment: Part II, W78-00952	3B	OFFICE OF WATER RESEARCH AND TECHNOLOGY, WASHINGTON, D.C. Sanitary Landfills, A Bibliography, Volume 2, W78-01004	5E	PRETORIA UNIV. (SOUTH AFRICA). DEPT. OF AGRICULTURAL ENGINEERING. Tests on Sprinklers (In Afrikaans), W78-00944	3F
Removing Iron from a Water Supply, W78-00954	5F	OHIO STATE UNIV. RESEARCH FOUNDATION, COLUMBUS. INST. OF POLAR STUDIES. Radiocarbon Dating of the Last Glaciation in Peru, W78-01009	2C	PRETORIA UNIV. (SOUTH AFRICA). DEPT. OF PLANT PRODUCTION. The Role of Water Nutrition and Yield Level in the Grain-Stalk Ratio of Maize (In Afrikaans), W78-00946	3F
Gass on Gas, W78-00956	2F	OIL AND NATURAL GAS COMMISSION, MADRAS (INDIA). Neutron Logging Method for Locating the Top of Cement Behind Borehole Casing, W78-00965	7B	PULP AND PAPER RESEARCH INST. OF CANADA, POINTE CLAIRE (QUEBEC). Treatment of Pulp and Paper Mill Effluents Using Physical-Chemical Techniques, W78-01111	5D
Impact of Abandoned Wells on Ground Water, W78-00968	6E	ORANGE FREE STATE UNIV., BLOEMFONTEIN (SOUTH AFRICA). The Influence of Certain Cultivation Practices on the Growth and Production of Zea Mays in Marginal Areas (In Afrikaans), W78-00947	3F	Toxicity, BOD, and Colour of Effluents from the Kraft Pulping of Bole Wood Containing High Quantities of Bark, W78-01128	5B
NAVAL UNDERSEA CENTER, SAN DIEGO, CA. Vortex Generation by Oscillatory Flow Over Rippled Surfaces, W78-00979	2L	THE PERIODS SENSITIVE TO INTERNAL PLANT MOISTURE STRESS DURING GROWTH AND DEVELOPMENT OF ZEA MAYS (IN AFRIKAANS), W78-00948	3F	PURDUE UNIV., LAFAYETTE, IN. LAB. FOR APPLICATIONS OF REMOTE SENSING. Computer-Aided Analysis of Skylab Multispectral Scanner Data in Mountainous Terrain for Land Use, Forestry, Water Resource, and Geologic Applications, W78-01059	7B
NEBRASKA UNIV., LINCOLN. DEPT. OF AGRICULTURAL ENGINEERING. Protection of a Unique Ecological Area Through Improved Water and Fertility Management, W78-01001	2G	THE EFFECT OF SEASONAL GRAZING ON THE INFILTRATION CAPACITY OF SOILS IN A CYMBOPOGON-THEMEDA VELD (IN AFRIKAANS), W78-00949	2G	QLM LABS., INC., OSWEGO, NY. A Plexiglass Subsampling Box for Large Benthos Samples, W78-00913	7B
NEW MEXICO STATE UNIV., UNIVERSITY PARK. DEPT. OF BIOLOGY. Underground Injection Program Set Under Safe Drinking Water Act, W78-00955	6E	OREGON STATE UNIV., CORVALLIS. DEPT. OF FISHERIES AND WILDLIFE. Toxicity to Fish of Cyanides and Related Compounds - A Review, W78-00927	5C	RAND CORP., SANTA MONICA, CA. Computations with the Rand Cloud Model for the Hiplex Workshop, June 1975, W78-01063	2B
NEW MEXICO STATE UNIV., UNIVERSITY PARK. DEPT. OF SYSTEMS AND CONTROL. Observation of Bilinear Systems with Application to Biological Control, W78-01183	5A	OREGON STATE UNIV., CORVALLIS. DEPT. OF FOOD SCIENCE AND TECHNOLOGY. Utilization of Cheese Whey for Wine Production, W78-01170	5E	RANDSE AFRIKAANSE UNIV., JOHANNESBURG (SOUTH AFRICA). Preliminary Results of a Survey of Freshwater Nematodes in South Africa, W78-01005	5C
NORTH CAROLINA STATE UNIV. AT RALEIGH. DEPT. OF BIOLOGICAL AND AGRICULTURAL ENGINEERING. State-of-the-Art: Swine Waste Production and Pretreatment Processes, W78-01169	5D	OREGON STATE UNIV., CORVALLIS. SCHOOL OF OCEANOGRAPHY. Threshold of Sediment Motion Under Unidirectional Currents, W78-01030	2J	RANDSE AFRIKAANSE UNIV., JOHANNESBURG (SOUTH AFRICA). NAVORSINGSGROEP VIR VARSWATERBIOLOGIE. The Use of the Isotope ³² P in the Study of Some Ecological Aspects of a Laboratory Stream Ecosystem (In Afrikaans), W78-00945	5A
NORTHWESTERN UNIV., EVANSTON, IL. DEPT. OF ENGINEERING SCIENCES; AND NORTHWESTERN UNIV., EVANSTON, IL. DEPT. OF GEOLOGICAL SCIENCES. The Time-Dependent Response of a Circular Basin of Variable Depth to a Wind Stress, W78-01141	2H	PARMA UNIV. (ITALY). Research on the Water Quality of the River Taro from Fornova to the Mouth (In Italian), W78-01016	5B	READING UNIV. (ENGLAND). DEPT. OF METEOROLOGY. Residual Flow and Boundary Shear Stress in the Turbulent Bottom Layer Beneath Waves, W78-01139	2L
PEN KEM, INC., CROTON-ON-HUDSON, NY. New State-of-the-Art Automatic Microelectrodes Instrumentation, W78-01132	5A	REGIONAL METEOROLOGICAL CENTRE, BOMBAY (INDIA). Monsoon in Sierra Leone, W78-01145	2B		

ORGANIZATIONAL INDEX

RESEARCH ASSOCIATION FOR THE PAPER AND BOARD, PRINTING AND PACKAGING INDUSTRIES, LEATHERHEAD (ENGLAND)

RESEARCH ASSOCIATION FOR THE PAPER AND BOARD, PRINTING AND PACKAGING INDUSTRIES, LEATHERHEAD (ENGLAND). Bio-Treatment of Effluents with BOD Below 100 MG/Liter, W78-01109	5D	SIMPSON PAPER CO., ANDERSON, CA. Water Quality Protection at the (Simpson Paper Company) Shasta Mill, W78-01130	5D	TECHNICAL UNIV. OF DENMARK, COPENHAGEN, INST. OF HYDRODYNAMICS AND HYDRAULIC ENGINEERING. Transition from Subcritical to Supercritical Flow, W78-00975	8B
RESERVE MINING CO., SILVER BAY, MN. Water Quality Studies of Sixteen Minnesota Rivers Tributary to Lake Superior, W78-01036	5A	SKELLY AND LOY, HARRISBURG, PA. Feasibility of Elk Creek Acid Mine Drainage Abatement Project, W78-01159	5D	TECHNICAL UNIV. OF DENMARK, LYNGBY. INST. OF HYDRODYNAMICS AND HYDRAULIC ENGINEERING. Gravity Waves on a Current: The Influence of Vorticity, A Sloping Bed, and Dissipation, W78-01014	2E
RHODE ISLAND UNIV., KINGSTON. Numerical Modeling of Pollutant Transport Using a Lagrangian Marker Particle Technique, W78-01069	5G	SLOVENSKA NARODNE MUZEUM, BRATISLAVA (CZECHOSLOVAKIA). Contribution to the Phytoplankton of the Bakanske Rameho, A Tributary of the Danube River (In Czech), W78-01116	5C	TECHNISCHE HOGESCHOOL, DELFT (NETHERLANDS). Erosion and Transport of Bed-Load Sediment, W78-01060	2J
RHODE ISLAND UNIV., KINGSTON. DEPT. OF ANIMAL SCIENCE. The Influence of Ammonia on the Oxygen Delivery System of Coho Salmon Hemoglobin, W78-00916	5C	SMITH INTERNATIONAL, INC., IRVINE, CA. SMITH TOOL DIV. Optimizing Penetration Rate, Conclusion: Computer Optimizes Operations, W78-00960	8A	TEXAS A AND I UNIV., WESLACO. CITRUS AND VEGETABLE TRAINING CENTER. Cost Comparison of Drip and Flood Irrigations Systems, W78-01048	3F
RHODE ISLAND UNIV., KINGSTON. DEPT. OF CIVIL AND ENVIRONMENTAL ENGINEERING. Electrical Resistivity for Estimating Permeability, W78-01010	2F	SMITH INTERNATIONAL, INC., IRVING. SMOTH TOOL DIV. Optimizing Penetration Rate, Part 1: Determining Parameters That Affect Rate of Penetration, W78-00959	8A	TEXAS A AND M UNIV., COLLEGE STATION. DEPT. OF OCEANOGRAPHY. An Analysis of Drag Coefficient at Hurricane Windspeeds from a Numerical Simulation of Dynamical Water Level Changes in Lake Okeechobee, Florida, W78-01023	2H
RHODE ISLAND UNIV., KINGSTON. GRADUATE SCHOOL OF OCEANOGRAPHY. Cenozoic Evolution of Antarctic Glaciation, the Circum-Antarctic Ocean, and Their Impact on Global Paleoceanography, W78-01138	2L	SOUTH AFRICAN BUREAU OF STANDARDS, PRETORIA. Is Your Swimming Pool Safe. W78-00932	5F	TEXAS TECH UNIV., LUBBOCK. WATER RESOURCES CENTER. Development of an Unconventional Approach to Nitrification-Denitrification, W78-01002	5D
ROBERT S. KERR ENVIRONMENTAL RESEARCH LAB., ADA, OK. Environmental Effects of Septic Tank Systems, W78-00967	5B	SOUTH AFRICAN MEDICAL RESEARCH COUNCIL, POTCHEFSTROOM; AND POTCHEFSTROOM UNIV. FOR C. H. E. (SOUTH AFRICA). Aspects of the Freshwater Mollusca of the Pongola River Flood Plain Pans, W78-01008	2E	THIOKOL CORP., BRIGHAM CITY, UT. Catalytic Waste Treatment Systems for Great Lake Ore Carriers, W78-01157	5D
ROCKWELL INTERNATIONAL CORP., CANOGA PARK, CA. Metal Removal and Cyanide Destruction in Plating Wastewaters Using Particle Bed Electrodes, W78-01173	5D	SOUTH AFRICAN SUGAR ASSOCIATION EXPERIMENT STATION, MOUNT EDGECOMBE. Irrigation of Sugar Cane, W78-00928	3F	THOKU REGION FISHERIES RESEARCH LAB., SHIOGAMA (JAPAN). Measurement of Periodic Open and Shut Shell Movement of Bivalves by the Strain-Gauge Method, W78-00911	7B
ROSENSTIEL SCHOOL OF MARINE AND ATMOSPHERIC SCIENCE, MIAMI, FL. Density-Induced Motions in Shallow Lagoons, W78-00951	2L	Implementation of Field Layout for Mechanization and Surface Water Control, W78-00942	4A	TOBACCO RESEARCH INST., RUSTENBURG (SOUTH AFRICA). The Influence of Fertilizer-Applied Chlorine, Chlorine Content of Irrigation Water and Leaching of Chlorine on the Uptake of Chlorine By Tobacco (In Afrikaans), W78-00943	3F
ROYAL VETERINARY AND AGRICULTURE COLL., COPENHAGEN (DENMARK). DEPT. OF PLANT PHYSIOLOGY AND ANATOMY. Structure of the Epidermal and Subepidermal Cells of Some Desert Plants of Israel, Anabasis Articulata and Calligonum Comosum, W78-01053	2I	SOUTHERN METHODIST UNIV., DALLAS, TX. DEPT. OF ANTHROPOLOGY. Late Pleistocene and Recent Climatic Changes in the Egyptian Sahara, W78-01043	2A	TOKYO UNIV. (JAPAN). Studies on Low Molecular Weight Compounds in Kraft Bleaching Liquor (In Japanese), W78-01117	5A
SAINT REGIS PAPER CO., PENSACOLA, FL. Color Increase of Treated Kraft Mill Effluents, W78-01131	5D	STONE CONTAINER CORP., COSHOCOTON, OH. Total Water System (AT) Coshocton Mill (OF) Stone Container Corporation, W78-01124	3E	TOUPS CORP. SANTA ANA, CA. Water Pollution Caused by Inactive Ore and Mineral Mines - A National Assessment, W78-01158	5B
SHIZUOKA PREFECTURAL INST. OF PUBLIC HEALTH (JAPAN). Follow-Up Investigation on Cyanide Complex Detected from Pulp Sludge (Seisi suragi kara kenshutsu sareta shian kagobutsu ni tsuite no tsuiseki chosa), W78-01174	5B	SULZER BROTHERS LTD. (SOUTH AFRICA). Mining Pumps for Heads in Excess of 1,500 M., W78-00930	8C	UNITED NATIONS WATER CONFERENCE, NEW YORK. Report of the United Nations Water Conference, Mar Del Plata, 14-25 March 1977. W78-00972	6E
SIMONS (H. A.) INTERNATIONAL LTD., VANCOUVER (BRITISH COLUMBIA). Outfall Diffuser Systems -- Design and Installation, W78-01126	8B	SWEDISH FOREST PRODUCTS RESEARCH LAB., STOCKHOLM. Closing up Kraft Mill Systems -- Reduction of Effluents and Control of Material Balances, W78-01108	3E	UNIVERSITY COLL. OF NORTH WALES, MENAI BRIDGE. MARINE SCIENCE LABS. Quantitative Studies on Marine Biodegradation of Oil, III. Comparison of Different Crude Oil Residues and Effects of Sea Water Source, W78-00907	5C

ORGANIZATIONAL INDEX

ZAGREB UNIV. (YUGOSLAVIA).

UNIVERSITY COLL. OF SWANSEA (WALES).	
DEPT. OF ZOOLOGY.	
Temporal Changes in the Plankton of an Industrialized Estuary, W78-00914	5B
UNIVERSITY OF THE PANJAB, LAHORE (PAKISTAN). DEPT. OF ZOOLOGY.	
Acute Toxicity of Four Organophosphorus Insecticides to a Freshwater Teleost Channa Punctatus (Bloch), W78-00919	5C
UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG (SOUTH AFRICA). DEPT. OF APPLIED MATHEMATICS.	
Solar Activity and Rainfall Variation Over Southern Africa, W78-00939	2B
UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG (SOUTH AFRICA). DEPT. OF BOTANY.	
A Simple Portable Vacuum Pump, W78-00931	5A
UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG (SOUTH AFRICA)	
HYDROLOGICAL RESEARCH UNIT.	
Lake St. Lucia: Mathematical Modelling and Evaluations of Ameliorative Measures, W78-01006	2H
URS CO., SEATTLE, WA. ; AND GEOLOGICAL SURVEY, PORTLAND, OR. WATER RESOURCES DIV.	
Hydrologic Analysis and River-Quality Data Programs, W78-01079	7A
UTAH INTERNATIONAL INC., SAN FRANCISCO, CA. ENVIRONMENTAL QUALITY DEPT.	
Mathematical Modeling of Natural Groundwater Recharge, W78-00974	2F
VANDERBILT UNIV., NASHVILLE, TN.	
Foam Flotation Treatment of Heavy Metals and Fluoride-Bearing Industrial Wastewaters, W78-01164	5D
VYZKUMNY USTAV LESNIHO HOSPODARSTVI A MYSLEVOSTI, ZBRASLAV-STRNADY (CZECHOSLOVAKIA).	
Regionalization for Forests Based on Their Significance for Water Management (Rajonizace lesa z hlediska jejich vodohospodarskeho vyznamu), W78-01118	3B
WISCONSIN DEPT. OF NATURAL RESOURCES, MADISON. DIV. OF ENVIRONMENTAL STANDARDS.	
Water Pollution Investigation: Lower Green Bay and Lower Fox River, W78-01022	5B
WISCONSIN UNIV., MADISON. DEPT. OF SOIL SCIENCE.	
Water and Chloride Movement Through Soil Columns Simulating Pedal Soils, W78-01011	2G
WISCONSIN UNIV.-MILWAUKEE. DEPT. OF GEOLOGICAL SCIENCES.	
Effects of Urban Lakes on Surface Runoff and Water Quality, W78-01135	2E

ACCESSION NUMBER INDEX

W78-00901	5C	W78-00979	2L	W78-01057	8G	W78-01135	2E
W78-00902	5C	W78-00980	2L	W78-01058	7B	W78-01136	2E
W78-00903	5C	W78-00981	2H	W78-01059	7B	W78-01137	7B
W78-00904	5C	W78-00982	5D	W78-01060	2J	W78-01138	2L
W78-00905	5C	W78-00983	5D	W78-01061	8A	W78-01139	2L
W78-00906	5A	W78-00984	5D	W78-01062	2C	W78-01140	2H
W78-00907	5C	W78-00985	3E	W78-01063	2B	W78-01141	2H
W78-00908	5B	W78-00986	2K	W78-01064	8B	W78-01142	2B
W78-00909	5G	W78-00987	5D	W78-01065	2G	W78-01143	2B
W78-00910	5D	W78-00988	5D	W78-01066	2B	W78-01144	2B
W78-00911	7B	W78-00989	5B	W78-01067	2E	W78-01145	2B
W78-00912	5A	W78-00990	2K	W78-01068	8B	W78-01146	2E
W78-00913	7B	W78-00991	5D	W78-01069	5G	W78-01147	2E
W78-00914	5B	W78-00992	8A	W78-01070	5A	W78-01148	2E
W78-00915	5C	W78-00993	8A	W78-01071	2A	W78-01149	2B
W78-00916	5C	W78-00994	5D	W78-01072	2J	W78-01150	2E
W78-00917	5A	W78-00995	5D	W78-01073	7B	W78-01151	2G
W78-00918	5C	W78-00996	5D	W78-01074	5D	W78-01152	8B
W78-00919	5C	W78-00997	6G	W78-01075	7C	W78-01153	2B
W78-00920	5C	W78-00998	2F	W78-01076	2A	W78-01154	2C
W78-00921	5C	W78-00999	2L	W78-01077	5A	W78-01155	7B
W78-00922	5C	W78-01000	5C	W78-01078	2H	W78-01156	5D
W78-00923	5A	W78-01001	2G	W78-01079	7A	W78-01157	5D
W78-00924	5B	W78-01002	5D	W78-01080	2H	W78-01158	5B
W78-00925	5C	W78-01003	6B	W78-01081	2F	W78-01159	5D
W78-00926	5B	W78-01004	5E	W78-01082	7C	W78-01160	5D
W78-00927	5C	W78-01005	5C	W78-01083	7C	W78-01161	5D
W78-00928	3F	W78-01006	2H	W78-01084	4B	W78-01162	5D
W78-00929	7B	W78-01007	2H	W78-01085	8A	W78-01163	5D
W78-00930	8C	W78-01008	2E	W78-01086	2F	W78-01164	5D
W78-00931	5A	W78-01009	2C	W78-01087	7C	W78-01165	5D
W78-00932	5F	W78-01010	2F	W78-01088	2H	W78-01166	5D
W78-00933	4A	W78-01011	2G	W78-01089	2F	W78-01167	5D
W78-00934	7C	W78-01012	4A	W78-01090	8B	W78-01168	5D
W78-00935	2L	W78-01013	2C	W78-01091	7C	W78-01169	5D
W78-00936	3D	W78-01014	2E	W78-01092	7C	W78-01170	5E
W78-00937	5B	W78-01015	5C	W78-01093	4B	W78-01171	5D
W78-00938	8D	W78-01016	5B	W78-01094	5B	W78-01172	5E
W78-00939	2B	W78-01017	2B	W78-01095	7B	W78-01173	5D
W78-00940	5A	W78-01018	2I	W78-01096	7C	W78-01174	5B
W78-00941	2I	W78-01019	5B	W78-01097	7C	W78-01175	5D
W78-00942	4A	W78-01020	5C	W78-01098	6D	W78-01176	5D
W78-00943	3F	W78-01021	5C	W78-01099	5C	W78-01177	5D
W78-00944	3F	W78-01022	5B	W78-01100	5D	W78-01178	5D
W78-00945	5A	W78-01023	2H	W78-01101	5D	W78-01179	5D
W78-00946	3F	W78-01024	5B	W78-01102	5A	W78-01180	2H
W78-00947	3F	W78-01025	2B	W78-01103	5D	W78-01181	5D
W78-00948	3F	W78-01026	8A	W78-01104	5D	W78-01182	5D
W78-00949	2G	W78-01027	8F	W78-01105	5D	W78-01183	5A
W78-00950	5C	W78-01028	6G	W78-01106	5D		
W78-00951	2L	W78-01029	2J	W78-01107	5D		
W78-00952	3B	W78-01030	2J	W78-01108	3E		
W78-00953	5F	W78-01031	2E	W78-01109	5D		
W78-00954	5F	W78-01032	8B	W78-01110	5D		
W78-00955	6E	W78-01033	2H	W78-01111	5D		
W78-00956	2F	W78-01034	2J	W78-01112	5D		
W78-00957	8C	W78-01035	2D	W78-01113	5A		
W78-00958	4C	W78-01036	5A	W78-01114	3E		
W78-00959	8A	W78-01037	2E	W78-01115	5D		
W78-00960	8A	W78-01038	2H	W78-01116	5C		
W78-00961	8C	W78-01039	2H	W78-01117	5A		
W78-00962	2F	W78-01040	2H	W78-01118	3B		
W78-00963	8C	W78-01041	2H	W78-01119	5A		
W78-00964	8C	W78-01042	2I	W78-01120	5E		
W78-00965	7B	W78-01043	2A	W78-01121	5D		
W78-00966	4B	W78-01044	6E	W78-01122	6E		
W78-00967	5B	W78-01045	4A	W78-01123	5D		
W78-00968	6E	W78-01046	2J	W78-01124	3E		
W78-00969	6E	W78-01047	6B	W78-01125	5D		
W78-00970	6E	W78-01048	3F	W78-01126	8B		
W78-00971	5D	W78-01049	3F	W78-01127	5D		
W78-00972	6E	W78-01050	2I	W78-01128	5B		
W78-00973	3F	W78-01051	10D	W78-01129	5D		
W78-00974	2F	W78-01052	4C	W78-01130	5D		
W78-00975	8B	W78-01053	2I	W78-01131	5D		
W78-00976	2L	W78-01054	2I	W78-01132	5A		
W78-00977	2D	W78-01055	3F	W78-01133	2L		
W78-00978	2L	W78-01056	2G	W78-01134	2B		

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B.

ABSTRACT SOURCES

SOURCE	ACCESSION NUMBER	TOTAL
A. CENTERS OF COMPETENCE		
Colorado State University, Irrigation Return Flow Quality	W78-00973	1
Cornell University, Policy Models for Water Resources Systems	W78-01068--01071	4
Franklin Institute (FIRL), Municipal and Industrial Wastewater Treatment Technology	W78-00991--00996 01073--01074 01156--01162 01164--01179 01181--01183	34
Illinois State Water Survey, Hydrology	W78-00974--00980 01009--01014 01023--01041 01056--01067 01133--01155	67
Institute of Paper Chem., Water Pollution from Pulp and Paper Industry	W78-00981--00985 00987--00989 01099--01115 01117--01132	41
National Water Well Association, Water Well Construction Technology	W78-00952--00971	20
University of Arizona, Arid Land Water Resources	W78-01042--01055	14
University of Wisconsin, Eutrophication	W78-01019--01022	4
B. STATE WATER RESOURCES RESEARCH INSTITUTES	W78-01001--01002	2

130 ABSTRACT SOURCES

SOURCE	ACCESSION NUMBER	TOTAL
C. OTHER		
BioSciences Information Service	W78-00910, 00912 00922, 00935 00986, 00990 01015--01018 01072, 01116 01163, 01180	14
Department of Water Affairs	W78-00928--00934 00936--00949 00997--01000 01005--01008	29
Environmental Information Services, Inc. (Effects of Pollutants on Aquatic Life)	W78-00901--00909 00911 00913--00921 00923--00927	24
National Oceanic and Atmospheric Administration	W78-00950--00951	2
Office of Water Research and Technology	W78-01003--01004	2
U. S. Geological Survey	W78-01075--01098	24

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